DOCUMENT RESUME

ED 185 369 CE 024 922

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TITLE Kansas Vocational Agriculture Education. Basic Core Curriculum Project, Horticulture II.
INSTITUTION Kansas State Univ., Manhattan. Dept. of Adult and Occupational Education.
SPONS AGENCY Kansas State Dept. of Education, Topeka. Div. of Vocational Education.
NOTE 485p.: Not available in paper copy due to colored paper. For related documents see CE 024 921 and CE 024 923
AVAILABLE FROM Vocational Curriculum Materials Center, Pittsburg State University, Pittsburg, KS 66762

EDRS PRICE MF02 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Agricultural Education: Agricultural Engineering: Course Content: Fertilizers: High Schools: *Horticulture: Learning Activities: Nurseries (Horticulture): Ornamental Horticulture: Plant Growth: Plant Pathology: Plant Propagation: State Curriculum Guides: Supervised Farm Practice: Teaching Guides: Units of Study: *Vocational Education
IDENTIFIERS Kansas

ABSTRACT

This second horticulture guide is one of a set of three designated as the basic core of instruction for horticulture programs in Kansas. Units of instruction are presented in eight sections: (1) Leadership, (2) Supervised Occupational Experience, (3) Plant Propagation, (4) Soil and Plant Growth Media, (5) Fertilizers, (6) Greenhouse, (7) Plant Problems and Controls, and (8) Horticulture Mechanics. Each unit is comprised of the following parts: terminal objective, specific objectives, information sheets, assignment sheets, and unit test. (LRA)

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ED185369

Kansas Vocational Agriculture Education

BASIC CORE CURRICULUM PROJECT

The identification of tasks performed by workers in the horticulture industry, and the preparation of instructional materials for use by teachers of horticulture programs.

HORTICULTURE II

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FOREWORD

This publication is one of a set of three designated as the basic core of instruction for horticulture programs in Kansas. The Kansas Horticulture core units will greatly assist instructors of vocational agriculture to effectively organize, plan and implement an instructional program for secondary students enrolled in vocational agriculture.

The horticulture industry is rapidly increasing in Kansas. Whether students or adults, we are in personal contact with many phases of horticulture in our daily lives. Fresh and processed fruits and vegetables are a part of our every day diets and are products of the horticulture industry. Likewise ornamental trees, shrubs, flowers and lawns are an established part of living as it relates to our homes, cities and highways. Because of this, horticulture offers many challenging opportunities in the tremendous use of horticulture plants for food, aesthetic and utility purposes and for students selecting a horticulture occupation. The student must also receive training through a supervised occupational experience program.

Appreciation is expressed to Dr. James Albracht for directing and coordinating the project, to the teachers who dedicated their time in developing individual units and to the industry specialists who provided the technical assistance in completing the units contained in this publication.

Les Olsen
Education Program Specialist
Agriculture Education

ACKNOWLEDGEMENTS

Appreciation is expressed to the many individuals for their assistance in the preparation of this publication. Special thanks are extended to the New Mexico State Department of Education for permission to use the New Mexico Core Curriculum as a source of information.

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LEADERSHIP

UNIT 1

BECOMING A GOOD LEADER

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to name characteristics of a good leader. They will be able to develop themselves into good leaders and demonstrate their ability to lead others. They will take a Personality Self-Rating Scale to determine how they rate as a leader. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Define leadership.
2. Select five characteristics of a good leader.
3. Discuss in a short paragraph why they want to become leaders.
4. Name four steps they must take in order to become good leaders.
5. Name five values of having a leadership ability.
6. Identify their leadership qualities on the Personality Self-Rating Scale. (Assignment Sheet #1)
7. Identify some leaders within their community and list three factors that identify each as a leader. (Assignment Sheet #2)

LEADERSHIP

UNIT 1

INFORMATION SHEET

I. Leadership - The combination of qualities which inspires confidence, draws others toward the leader, and causes them to follow.

II. Characteristics of a Good Leader

- A. Preparedness - Know leadership takes work as well as practice.
- B. Group mindedness - Regard yourself as a part of the group. Say "we" instead of "I"; don't try to run the crowd. Instead, be guided by the crowd's wishes.
- C. Consideration for others - Be understanding and friendly.
- D. Poise - Don't let irritations bother you.
- E. Humility - Be confident, but not cocky; don't be afraid to reveal you don't know everything.
- F. Hard work - Don't ask anyone to do something that you would not be willing to do yourself.
- G. Responsibility - Live up to your word and duties.
- H. Cooperativeness - Know how to work with others and enjoy working with them.
- I. Happiness - Enjoy life; The simple things as well as the big.
- J. Imagination - Help the persons in your group to learn and grow through the activities.
- K. Preciseness - Be able to express yourself effectively.
- L. Pride - Take pride in what you do; take pride in being a leader.
- M. Neatness - Always be neat in dress and personal appearance.
- N. Courtesy - The words "please" and "thank you" pay dividends; use them often.
- O. Understanding - Know members' opinions and be ready to meet changing situations.
- P. Ambition - Set goals and make them high, but be sure to reach them.
- Q. Openmindedness - Take advice, but do your own thinking.
- R. Curiosity - Analyze all the facts before you draw conclusions.
- S. Energy - Do your best at all times; plan to make the most effective use of your time.

III. Reasons to Become a Good Leader

- A. Leadership needed in all fields
- B. Challenge to learn
- C. Creates respect for others

INFORMATION SHEET

D. Aids in maturity

IV. Steps in Becoming a Good Leader
   A. Leaders are made, not born
   B. Study qualities of a good leader
   C. Evaluate weak and strong points of yourself
   D. Become a good follower
   E. Develop a plan for training yourself as a leader

V. Values of having leadership ability
   A. Education
   B. Respect
   C. Advancement in an occupation
   D. Financial betterment
   E. Pride
   F. Security

LEADERSHIP

UNIT 1

ASSIGNMENT SHEET #1: Personality Self-Rating Scale

Circle the appropriate number following each trait. Four is outstanding, three is above average, two is average, one is poor. Total your score below.

1. Do I maintain well groomed appearance? 1 2 3 4
2. Do I have a pleasing voice? 1 2 3 4
3. Is my posture alert and poised? 1 2 3 4
4. Is my disposition cheerful? 1 2 3 4
5. Do I make friends easily? 1 2 3 4
6. Do I exert a positive leadership? 1 2 3 4
7. Am I generally thoughtful of the feelings of others? 1 2 3 4
8. Is my enthusiasm sincere and contagious? 1 2 3 4
9. Do I persevere until I achieve success? 1 2 3 4
10. Am I sincere in my interest in other people? 1 2 3 4
11. Am I ambitious to get ahead? 1 2 3 4
12. Do I get along well with others? 1 2 3 4
13. Do I react constructively to criticism? 1 2 3 4
14. Do I remember names and faces? 1 2 3 4
15. Am I punctual on all occasions? 1 2 3 4
16. Do I have and evidence a spirit of cooperation? 1 2 3 4
17. Am I free from prejudice? 1 2 3 4
18. Do I know how people react in most situations? 1 2 3 4
19. Am I generally a good listener? 1 2 3 4
20. Do I refuse to allow what other people say to hurt me? 1 2 3 4
21. Can I criticize without giving offense? 1 2 3 4
22. Do I usually like people for what they are, or do I wait to see if they like me? 1 2 3 4
23. Do I enjoy being part of a group? 1 2 3 4
24. Am I reliable? 1 2 3 4
25. Can I adapt myself to all situations? 1 2 3 4
26. Am I easily discouraged? 1 2 3 4
27. Do I apply myself to the problems of each day? 1 2 3 4
28. Can I make a decision quickly and accurately? 1 2 3 4

ASSIGNMENT SHEET #1: Personality Self-Rating Scale

29. Am I loyal to my superiors and associates? 1 2 3 4

30. Do I try to get the other fellow's point of view? 1 2 3 4

31. Am I neat and clean in my work as well as my personal appearance? 1 2 3 4

32. Do I know where I make my mistakes, and do I admit them? 1 2 3 4

33. Am I looking for opportunities to serve others better? 1 2 3 4

34. Am I following a systematic plan for improvement and advancement? 1 2 3 4

35. Can I accept honors and advancements and yet keep my feet on the ground? 1 2 3 4

36. Am I playing the game of life honestly and fairly with myself, my fellow members, and others with whom I work? 1 2 3 4

R

LEADERSHIP

UNIT 1

EVALUATION OF ASSIGNMENT SHEET #1

And now, to evaluate your scores - If your score totaled over 100, your personality rating is definitely superior. And, if you've been honest with yourself, you are among the people who are most likely to succeed. 90 - 100 is above average. 75 - 90 is average. Below 75 shows plenty of room for improvement. How did you rate?

LEADERSHIP

UNIT 1

ASSIGNMENT SHEET #2: Identifying Leaders Within Your Community

Identify three individuals in your local community which appear to you as good leaders. After you have identified the leaders, list three factors that identify them as such.

NAME	LEADERSHIP QUALITIES
1. ______________________________	a. ______________________________
	b. ______________________________
	c. ______________________________
2. ______________________________	a. ______________________________
	b. ______________________________
	c. ______________________________
3. ______________________________	a. ______________________________
	b. ______________________________
	c. ______________________________

LEADERSHIP
UNIT 1
TEST

1. Define leadership.

2. Select (5) characteristics of a good leader. Place an "X" by the correct characteristics.

   _____a. Be well prepared
   _____b. Be responsible
   _____c. Have low goals
   _____d. Take advice
   _____e. Have no pride
   _____f. Be neat
   _____g. Get the facts

3. Why do you want to become a good leader?

4. What are four steps to follow in becoming a good leader?

5. Name five values of having leadership ability.

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

SUPERVISED OCCUPATIONAL EXPERIENCE

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to select a Horticulture job from the various types of jobs available, establish goals for horticulture programs, and set ways and means of reaching those goals. The student will be able to apply fundamentals of beginning record keeping. Each student will complete the record book with all business figures 100 percent accurate. The information pages in the record book should be ninety percent accurate.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Complete occupational information form. (Assignment Sheet #1)
2. Develop plans for attaining career objectives. (Assignment Sheet #2)
3. Identify skills needed for success in the horticulture industry. (Assignment Sheet #3)
4. Develop a supervised occupational experience agreement. (Assignment Sheet #4)
5. Complete the horticulture record book to the satisfaction of the instructor.

SUPERVISED OCCUPATIONAL EXPERIENCES

UNIT 1

INFORMATION SHEET NO. 1

Candidate Occupational Objectives: To become the manager of the Uniontown Greenhouse.

What it will take to reach this occupational objective.	Plan for reaching occupational objective	Extent of experience already received in reaching occupational objective.
Experience Work in as many areas in this field so my training experiences will start me on my way towards my career goal of managership of a Greenhouse.	Work in greenhouse in Uniontown while in high school during the school year and extend into summer employment.	I am currently employed in a greenhouse in Uniontown and have set up a 3 year plan of experiences to be completed here and have an agreement with Mr. Smith for summer employment and after two years of Voc-Tech, I plan to return technican in this greenhouse.
Education 2 years Vo-Tech and major in Horticulture	Plan to attend Vo-Tech for 2 years major in Horticulture	Three months working in greenhouse.
Cost $1300 plus room and board	Save money earned while on job to finance education.	Earned $396 while in employment in greenhouse (9/1 - 12/31) Saved = ?
Other		

SUPERVISED OCCUPATIONAL EXPERIENCES

UNIT 1

INFORMATION SHEET NO. 2

Specific experience to be gained: Indicate the specific experiences to be gained that will assist in achieving your desired career goal.

Occupational Objective Manager of a Greenhouse

Name of business in which horticulture experience is obtained.	Specific Experience and/or skills developed	Indicate how each experience will assest you towards achieving your occupational goal.
Uniontown Greenhouse	Organization of planting area.	a. Realizing the value of a clean greenhouse. b. Understanding the value of proper plant arrangement. c. Training in organizing the greenhouse.

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

INFORMATION SHEET NO. 3

Supervised Occupational Experience Agreement

Example:

Starting Date: 9/1/74

Ending Date: 8/21/78: with chance for employment while in Vo-Tech and also after completion of schooling.

Hours: 2 hours after school each day with 8 hours on Saturday; 44 hours during summer each week with three weeks off.

Wages: Start at $2.20 per hour with increase of $.10 per hour each two months up to $3.00 per hour while in school.

Experiences:

1. Learn responsibilities to the company:
    a. Attitude
    b. Communications
    c. Employee economies
2. Organization of greenhouse area and supply storage.
3. Learn to be a greenhouse helper and take directions.
4. Procedure in loading and delivering plants.
5. Repair and assembling equipment problems.
6. Learn to read labels and locate supplies in storage area.
7. Learn to start, keep and price a customer's bill.
8. Learning to order supplies and check them in.
9. Develop skills in salesmanship of products.

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

INFORMATION SHEET NO. 4

FORM 06-01-114

KANSAS STATE DEPARTMENT OF EDUCATION
Topeka, Kansas 66612

Division of Vocational Education

MEMORANDUM OF TRAINING PLAN

COOPERATIVE TRAINING PROGRAM

- ☐ Agriculture
- ☐ Distributive Education
- ☐ Health
- ☐ Home Economics
- ☐ Industrial Education
- ☐ Office Education
- ☐ Special Vo-Ed Programs

School ______________________ City ______________________

The ______________________ will permit ______________________
Training agency Student

to enter their establishment for the purpose of gaining knowledge and experience as (a) (an)

____
Occupation O. E. Code No. Beginning Wage

The course of training is designed to run for a school year with a minimum of 450 hours per school year. The training will be in accordance with the outline of training below, made and agreed upon by the employer and coordinator.

TRAINING OUTLINE (Use back of sheet)

(FOR HAZARDOUS OCCUPATIONS ONLY)

A. The work of the student-learner in occupations declared hazardous shall be incidental to his training, shall be intermittent and for short periods of time, and shall be under the direct and close supervision of a qualified and experienced person.

B. Safety instruction shall be given by the school and correlated by the employer with on the job training.

GENERAL PROVISIONS OF TRAINING

1. The school will make provision for the student to receive related and technical job instruction.
2. The status of the student while in training shall be that of student-learner.
3. The student while in training shall progress from job to job in order to gain experience in various operations.
4. The schedule of compensation shall be in accordance with existing local standards, labor laws, and policies.
5. The coordinator will assist with adjustment of any problems of the student.
6. The parent or guardian shall be responsible for the conduct of the student while in training.
7. The coordinator shall have authority to transfer or withdraw the student when he deems such action to be to the best interests of those concerned.
8. The student promises to abide by all implied and stated terms included in this training plan.
9. Employment of this student-learner does not displace a full-time employee.
10. The student shall be subject to discharge at any time because of inefficiency or because of conditions within the industry or concern, upon notification of the coordinator.
11. This training plan may be cancelled for sufficient cause at any time provided due notice is given to all parties concerned.
12. On-the-job training is an integral part of this instructional program.

By ______________________ ______________________
Employer Parent or Guardian

______________________ ______________________
Coordinator Student

______________________ Date ______________________ 19____
Job instructor

White copy to Training Agency—Yellow to Trainee—Pink to Coordinator—Green to State Department of Education

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

ASSIGNMENT SHEET NO. 1

Date entered high school ________________________________

Years of Horticulture offered in high school ________________

Years of Horticulture completed ____________________________

Enrolled in Horticulture (yes, no) _________________________

Parents name, if living: Father ____________________________

Mother ____________________________

Number of brothers ________________ ages ______________

Number of sisters ________________ ages ______________

Father's Occupation ________________________________

Mother's Occupation ________________________________

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

ASSIGNMENT SHEET NO. 2

Qualifying Programs: Programs that provide exploratory experiences and to develop occupational competencies needed by individuals preparing to enter the occupational field of horticulture. Experiences may be in florist shops, garden center, and landscape maintenance firms.

A. Applicant's Vocational Objective: (To be completed by the applicant) State your ultimate career goal and your plan for achieving this goal.

Candidate's Occupational Objective ____________________

What it will take to reach this occupational objective	Plans for reaching occupational objective	Extent of experiences already received in reaching occupational objective
Experience:		
Education:		
Cost:		
Other:		

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

ASSIGNMENT SHEET NO. 3

Specific Experiences to be gained: Indicate the specific experience to be gained that will assist in achieving your desired career goal.

Name of Business Horticulture experience is found.	Specific experience and/or skills developed.	Indicate how each experience will assist you towards achieving your occupational goal.

SUPERVISED OCCUPATIONAL EXPERIENCE

UNIT 1

ASSIGNMENT SHEET NO. 4

Supervised Occupational Agreement (Experiences to be gained)

Starting date: ____________________

Ending date: ____________________

Hours: ____________________

Wages: ____________________

Experiences: ____________________

Example: I. Growing Plants
- A. Mums
  1. Learn to mix soil properly
  2. Learn to fertilize properly
  3. Learn to water properly

PLANT PROPAGATION

UNIT 1

INTRODUCTION TO SEXUAL PLANT PROPAGATION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify sexual plant propagation terms, to list methods of plant propagation; the plant reporduction cycle; the names, functions, and locations of the male and female parts of a flower; and the means of sexual plant reproduction. They will also be able to take a flower apart properly for the purpose of locating and recording the placement of the parts that pertain to sexual plant propagation. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to sexual propagation and reproduction with their definitions.
2. Employ words in a given incomplete sentence defining propagation that make the sentence true.
3. Name two kinds of plant propagation.
4. List six steps in the plant reproduction cycle.
5. Name parts and functions of the male and female parts of a flower.
6. Name eight stwps in the plant reproduction process.
7. List two means of sexual plant reproduction.
8. Employ words in a given incomplete sentence concerning self-pollination that make the sentence true.
9. Employ words in a given incomplete sentence concerning cross-pollination that make the sentence true.
10. Take apart a flower in the correct way, and by examination, label the parts correctly on a given drawing.

PLANT PROPAGATION
UNIT 1
INFORMATION SHEET

I. Terms and Definitions:

A. Pollen - Fine powder-like material that contains the male germs, formed within the anther of a flowering plant.

B. Ovule - The body within the ovary containing the female egg which, upon fertilization, becomes the seed.

C. Ovary - The portion of the pistil in which the ovules are produced.

D. Gamete - A sexual reproductive cell.

E. Embryo - The first stage of a plant within the seed, which makes its appearance soon after fertilization of the ovule by the pollen and then passes through a period of rest until the sprouting of the seed.

F. Placenta - The part of the ovary that supports the ovules.

G. Sexual Propagation - Reproduction in plants involving the union of the male flower parts and the female flower parts to form a seed.

H. Asexual Propagation - Methods of propagation which involve an already growing part or parts of a plant, such as layering, division, cutting, grafting, and budding (Block III, Unit 1 through 6).

I. Pistil - Female part of a flower.

J. Stamen - Male part of a flower.

K. Stigma - Part of the pistil that receives male pollen.

L. Filament - Elongated stalk of the stamen that holds the anther; part of the stamen.

M. Anther - Part of the stamen that produces the pollen.

N. Style - A tubelike structure of the pistil through which male pollen tube travels to ovules.

II. Plant Propagation - The reproduction of plants to enable the productions of desired kinds and quantities of plants.

III. Kinds of Propagation

A. Sexual Propagation (Reproduction from seed)

B. Asexual Propagation (Reproduction from vegetative parts)

INFORMATION SHEET

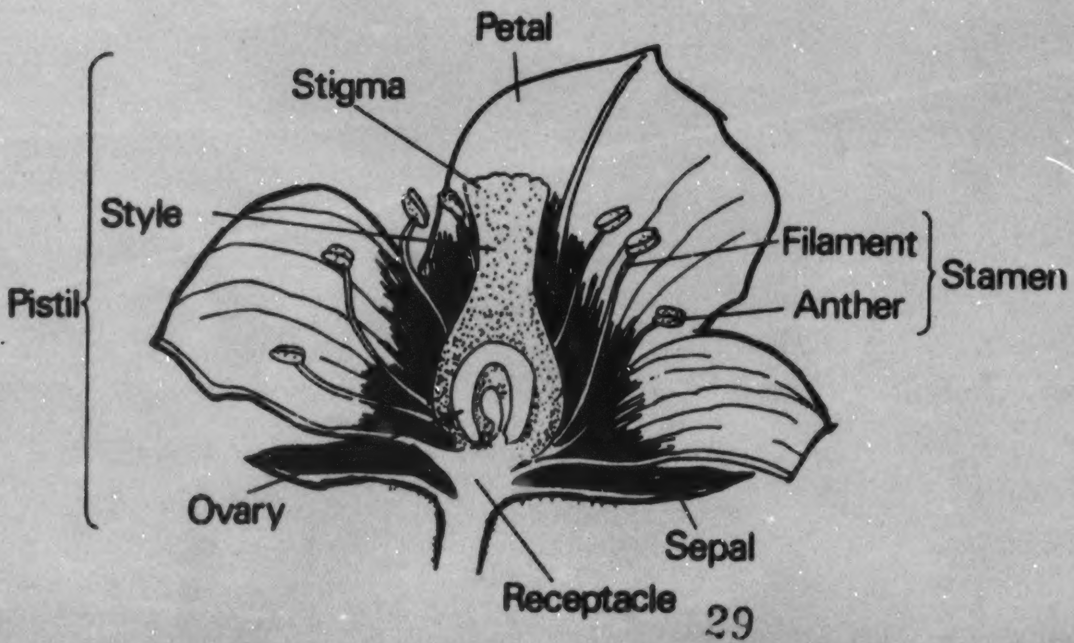
IV. The Cycle of Sexual Reproduction in Plants (See TM 1 - Cycle of Reproduction

- A. Seed germinates.
- B. Plant grows.
- C. Flowering plant matures.
- D. Fertilization takes place.
- E. Seed develops.
- F. Seed ripens and is dispersed (spread around). New cycle starts.

NOTE: Review Parts of a Flower. (TM 2)

V. The Functioning Parts of the Flower in Plant Reproduction.

- A. Male part of flower is the stamen, consisting of:
  1. Filament (elongated stalk that hold the anther.)
  2. Anther (produces pollen).
- B. The female part of the flower is called the pistil, consisting of:
  1. Stigma (sticky so that it can receive the pollen moisture in germination of pollen).
  2. Style (tube-like structure that the male pollen tube travels through to fertilize the eggs).
  3. Ovary (compartment containing ovule to be fertilized.)



INFORMATION SHEET

C. The endosperm's function is to contain stored food supply eventually to be used by the plumule. (Remember: The Endosperm exists only in monocot plant seedlings.)

VI. The Process of Plant Reproduction

A. After the stamen of the flower has matured . . .

B. Pollen is released and finds the way to the stigma . . .

C. Pollen germinates and sends a pollen tube down the style to an ovule in the ovary . . .

D. Male gametes have been formed and move down the pollen tube. They enter the ovule and fertilization takes place . . .

E. Cell division takes place and an embryo is formed.

F. The embryo (forming seed) is attached to the placenta (See TM 2). . .

G. Through the placenta the developing seed and plant receive food for growth and storage from the mother plant.

H. Food is manufactured through photosynthesis in the leaves and stored in the seed.

VII. Means of Sexual Plant Reproduction

A. Self-Pollination

B. Cross-Pollination

VIII. Self-Pollination.

A. Self-pollination can take place when the flower contains both male and female reporductive parts; i.e., is a perfect flower.

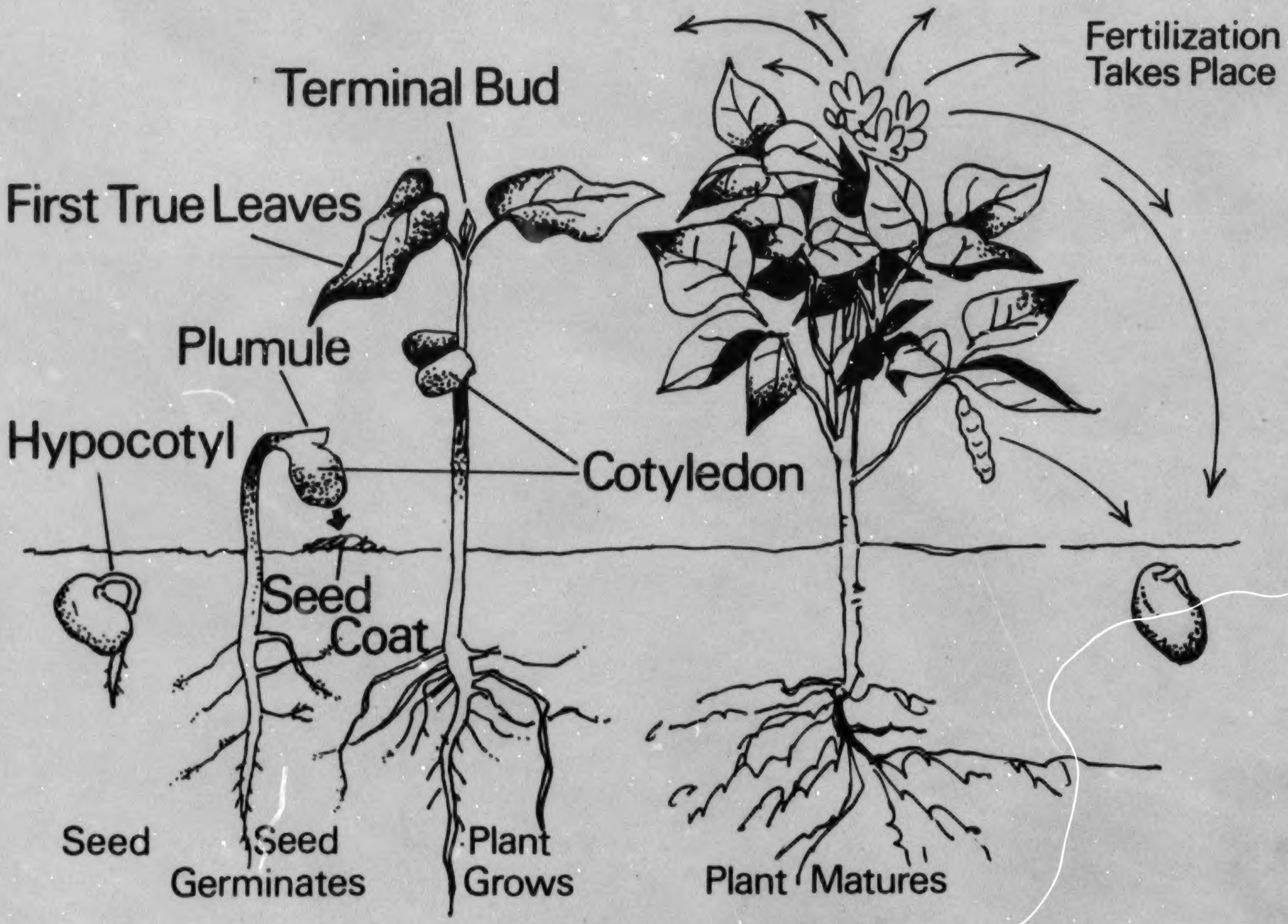
B. Pollination occurs by means of wind, insects, and/or people, whenever anther touches stigma.

IX. Cross-Pollination.

A. Cross-pollination can take place when the flower contains one sex, either male or female reproductive parts; i.e., an imperfect flower. Cross-pollination can also take place in a perfect flower when the pistil and stamens mature at different times, and are unable to self-pollinate.

B. Pollination occurs by means of wind, insects, and/or people.

Reproductive Cycle in Plants



Fertilization
Takes Place

Terminal Bud

First True Leaves

Plumule

Hypocotyl

Cotyledon

Seed
Coat

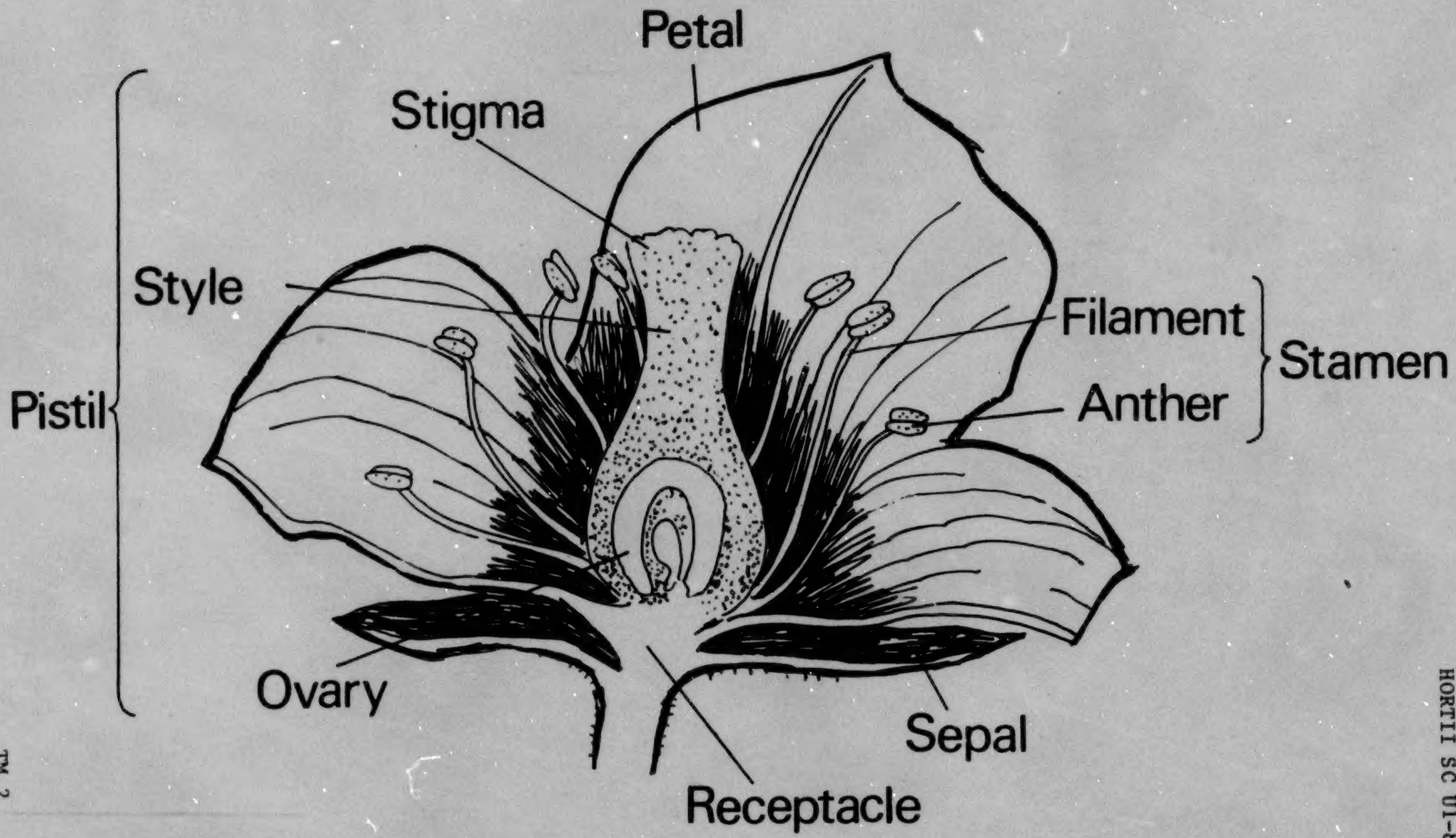
Seed

Seed
Germinates

Plant
Grows

Plant Matures

Reproductive Parts of a Flower


Petal
Stigma
Style
Pistil
Filament
Stamen
Anther
Ovary
Sepal
Receptacle

TM 2

HORTII SC U1-8

PLANT PROPAGATION

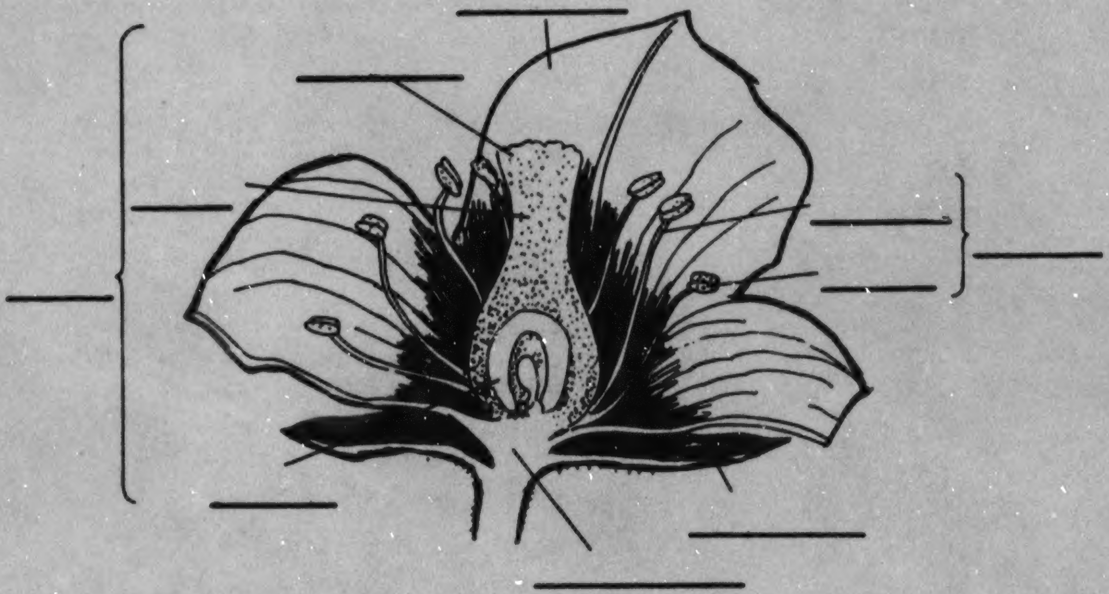
UNIT 1

ASSIGNMENT SHEET #1: Name the Plant Parts

I. Do the following:

A. Place the names of the part of the flower on the drawing and label.

B. Instructor will evaluate.



PLANT PROPAGATION
UNIT 1

ASSIGNMENT SHEET #2: Match Terms and Definitions

I. Match the following: (Instructor will evaluate)

_____A. Stamen
_____B. Pistil
_____C. Asexual Propagation
_____D. Gamete
_____E. Ovary
_____F. Ovule
_____G. Pollen
_____H. Sexual Propagation
_____I. Placenta
_____J. Embryo
_____K. Stigma
_____L. Filament
_____M. Anther
_____N. Style

1. Fine powder-like material that contains the male germ, formed within the anther of a flowering plant - the fertilizing element in a seed plant.
2. The body within the ovary containing the female egg which, upon fertilization becomes the seed.
3. The portion of the pistil in which the ovules are contained.
4. A sexual reproductive cell.
5. The first stage of a plant within the seed, which makes its appearance soon after fertilization of the ovule by the pollen.
6. The part of the ovary that supports the ovules.
7. Reproduction from seed, involving the union of male and female plant parts before seed is formed.
8. Methods of propagation involving already growiing parts of a plant.
9. Female part of a flower.
10. Male part of a flower.
11. Part of the pistil that receives male pollen.
12. A tube-like structure of the pistil through which male pollen tube travels to ovules.
13. Part of the stamen that hold the anther.
14. Part of the stamen that produces the pollen.

9

PLANT PROPAGATION

UNIT 1

JOB SHEET #1: Principal Parts of a Flower.

I. Materials Needed:

A. Flower in which the parts can easily be identified.

B. Magnifying lens.

C. Sharp knife.

II. Procedure:

A. Use the drawing below.

B. Carefully cut away the corolla (petals) to expose the inside of the flower. Be sure to label your drawing of the flower as you remove each flower part.

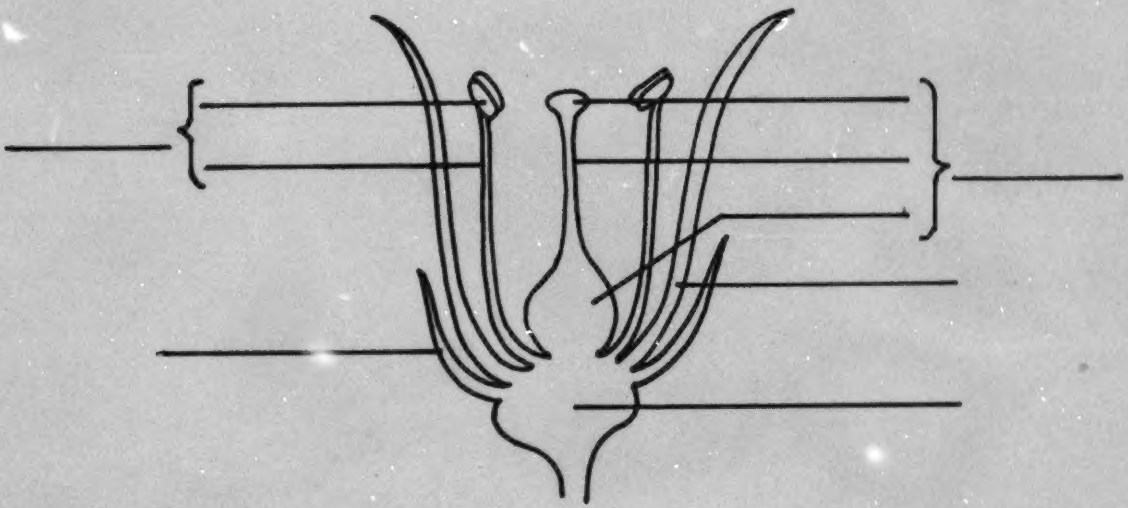
C. Carefully remove the stamens. Remember these consist of the filament and anther.

D. The "bottle-shaped" organ exposed is the pistil. It consists of the stigma, style, and ovary.

E. The calyx (sepals) is the green-like leaves at the base of the flower.

F. The receptacle is at the tip of the stem where the flower is borne.

G. After you have labeled the drawing, your instructor should check it to make sure you have labeled it correctly.



PLANT PROPAGATION

UNIT 1

TEST

1. Match:

______a. Stamen
______b. Pistil
______c. Asexual
______d. Gamete
______e. Ovary
______f. Ovule
______g. Pollen
______h. Sexual
______i. Placenta
______j. Embryo
______k. Stigma
______l. Filament
______m. Anther
______n. Style

1. Fine powder-like material that contains the male germ, formed within the anther of a flowering plant, the fertilizing element in a seed plant.
2. The body within the ovary containing the female egg which, upon fertilization becomes the seed.
3. The portion of the pistil in which the ovules are contained.
4. A sexual reproductive cell.
5. The first stage of a plant within the seed, which makes its appearance soon after fertilization of the ovule by the pollen.
6. The part of the ovary that supports the ovules.
7. Reproduction from seed involving the union of the male and female flower parts before the seed is formed.
8. Methods of propagation involving already growing parts of a plant.
9. Reproduction from cuttings.
10. Male part of a flower.
11. Part of the pistil that receives male pollen.
12. Tube-like structure of the pistil through which male pollen tube travels to ovules.
13. Part of the stamen that holds the anther.
14. Part of the stamen that produces the pollen.

2. Fill the blanks in this statement:

a. Plant propagation is the ____________________________ of plants to enable the ____________________ of desired ____________________ and quantities of plants.

TEST

3. Name two kinds of plant propagation.

4. Name the six steps in the cycle of plant reproduction.

5. List the functions and parts of the following:

   a. Female part of the flower is called a pistil.

Part	Function
1. ____________________	1. ____________________
2. ____________________	2. ____________________
3. ____________________	3. ____________________

   b. Male part of the flower is called the stamen.

1. ____________________	1. ____________________
2. ____________________	2. ____________________
3. ____________________	3. ____________________

6. Name eight steps in the process of plant reproduction.

7. List two means of sexual plant reproduction.

8. Fill in blanks of these statements:

   a. Flowers that are ________________ contain both male and female reproductive parts, and are called ______________________ flowers.

   b. Pollination in the flowers mentioned in a. occurs by means of ________________________ and/or ___________________________.

10. Perform job in Job Sheet #1 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 2

SEEDS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terms that pertain to seeds; to state factors pertaining to successful seed propagation; to name parts and functions of a seed; to name factors affecting seed germination; to list the steps in seed germination; and to name factors affecting the viability of seeds. They will also be able to analyze a seed as to its parts and determine the relative effects of environment upon growth. This objective will be considered achieved upon successful performance of the job assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to seeds with definitions.
2. List four factors on which successful seed propagation depends.
3. Name two purposes of good seed propagation technique.
4. State four reason why plants are propagated from seeds.
5. State three main parts of a seed and functions of each.
6. Match names of seed parts with descriptions or functions.
7. Name four factors affecting seed germination.
8. List seven steps in sequence of seed germination.
9. Name five factors affecting viability of seeds.
10. Analyze bean seeds by exposing their parts, and label a given drawing correctly as a result of the analysis. (Job Sheet #1)
11. Plant given seeds in different environments and record the effects of each environment on growth. (Job Sheet #2)

PLANT PROPAGATION

UNIT 2

INFORMATION SHEET

I. Terms and Definitions.

A. Seed propagation - Increase in the plant population by seeds.

B. Viability - Ability of a seed to be able to germinate, or come to life.

C. Propagation - The controlled reproduction of plants.

D. Variety - A group of closely related plants of common origin which have similar characteristics.

E. Seed - A ripened ovule.

F. Cotyledons - Seed leaves of the embryo; also the food storage area for dicotyledonous seeds.

G. Discotyledonous plants - Plant with two seed leaves in the seed.

H. Embryo - Small dormant plant inside the seed coat.

I. Endosperm - Special food storage area for monocotyledonous seeds.

J. Monocotyledonous plants - Plants with one seed leaf in the seed.

K. Plumule - The growth bud located at the apex where new growth begins.

L. Seed Coat - Covering which encloses the internal parts of a seed.

M. Dormant condition - A time during which no growth occurs because of unfavorable environment.

N. Seed germination - Process in which the embryo resumes growth.

O. Damping-off - A disease which attacks seedlings at the soil line and kills them. This occurs under wet, humid conditions when the disease is present.

II. Successful Seed Propagation.

A. Selection of the proper seed to reproduce the particular variety of plant that the propagator wishes to grow.

B. The seed's being viable, so that it will produce a vigorous seedling that will grow into a quality plant.

C. Breaking of any dormancy.

D. The seed's being placed in an environment that will enable it to germinate and to grow.

III. Purposes of Good Seed Propagation Tenchique.

A. To preserve the characteristics of a particular kind of plant.

B. To increase number of plants.

IV. Reasons for Propagating Plants from Seeds.

A. Some plants may not propagate by other means.

B. It is the least expensive way.

C. It is the fastest way in some cases.

D. It is the best way to obtain new varieties and strains.

E. It is the best way to obtain hybrid seed.

F. It is the best way to develop an entirely different plant.

V. Main Parts of a Seed.

A. Seed Coat

B. Embryo - an embryo has three parts

1. Cotyledons (the beginnings of seed leaves)

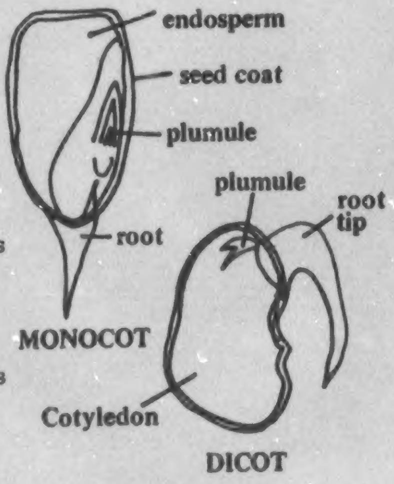
a. Cotyledons for dicotyledonous plants (called "dicots" for short) consist of the beginnings of two seed leaves; e.g., bean.

b. Cotyledons for monocotyledonous plants (called "monocots" for short) consist of the beginnings of one seed leaf; e.g., corn.

2. Plumule (a growth bud)

2. Root tip

C. Endosperm (exists only in monocotyledonous plants; i.e., monocots).



VI. Functions of Seed Parts.

A. The seed coat has three principal functions:

1. To keep the seed from drying out.

2. To contain the food supply for the new plant.

3. To protect the embryo from mechanical injury.

B. The embryo's functions differ in dicots and monocots.

1. The functions of dicot cotyledons are to serve as the place where food for the new plant is stored, and as protection of the plumule.

2. The function of a monocot cotyledon is to serve as protection of the plumule.

3. The function of both monocot and dicot plumules is to contain the growth potential for the new plant.

INFORMATION SHEET

4. The functions of both monocot and dicot root tips are to hold the developing plant in the soil and to take in nutrients and water from the soil.

C. The endosperm's function is to contain stored food supply eventually to be used by the plumule. (Remember: The Endosperm exists only in monocot plant seedlings.)

VII. Factors Affecting Seed Germination

A. Quality of Seed

B. Characteristics of the germination medium - A good germination medium shoud be:

1. Finely screened yet porous, loose, open
2. One in which water flows quickly and easily
3. Low in nutrient
4. Sterilized

C. Moisture.

D. Temperature

E. Air or Oxygen

F. Maturity of the Seed.

G. Presence or absence of Light

VIII. Steps in Seed Germination

A. Seed absorbs or soaks up water.

B. Seed coat softens and gets bigger.

C. Seed swells and splits the seed coat.

D. Primary root emerges through the split and grows downward to form the root.

E. Upper part of the plant emerges from the soil.

F. Cotyledon (or cotyledons) open up above the ground.

G. True leaves (plumule) unroll or unfold exposing the growth bud and allowing the plant to begin to grow.

IX. Factors Affecting Viability of Seeds

A. Damaged seeds - from heat, insects or rodents, and/or mechanically broken seed coats.

B. Old seed - seeds over a year old that have not been stored properly.

C. Wetness in soil or media - if too wet, oxygen cannot easily move around seed.

INFORMATION SHEET

D. Temperature - if too cold, plant develops slowly, uses up food supply, and slows water absorption. Optimum temperature is 70°F.

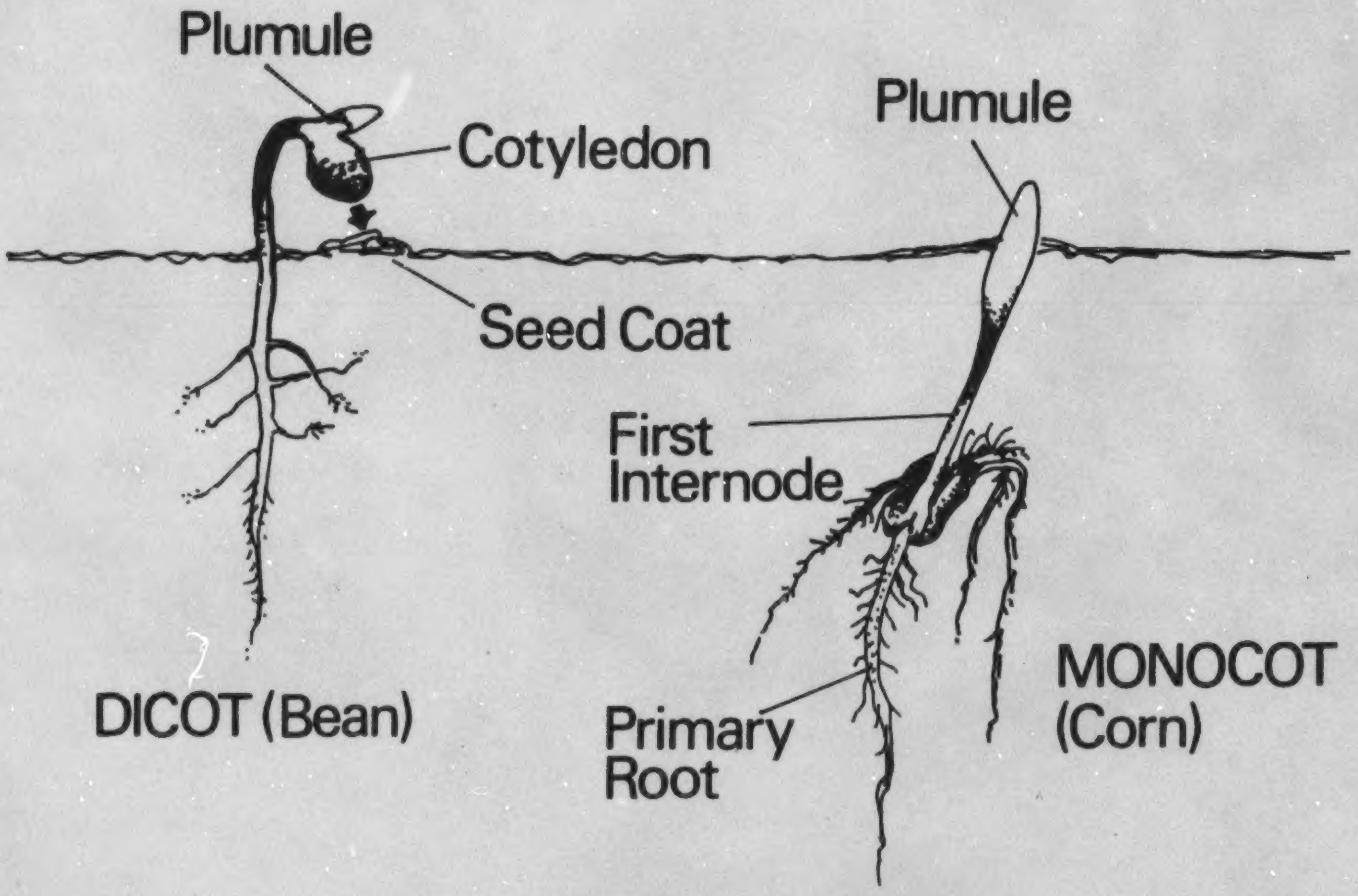
E. Hardness of seed - if too hard, moisture will not enter seed coat.

F. Disease - from bacteria or fungi carried by air, water, and/or insects.

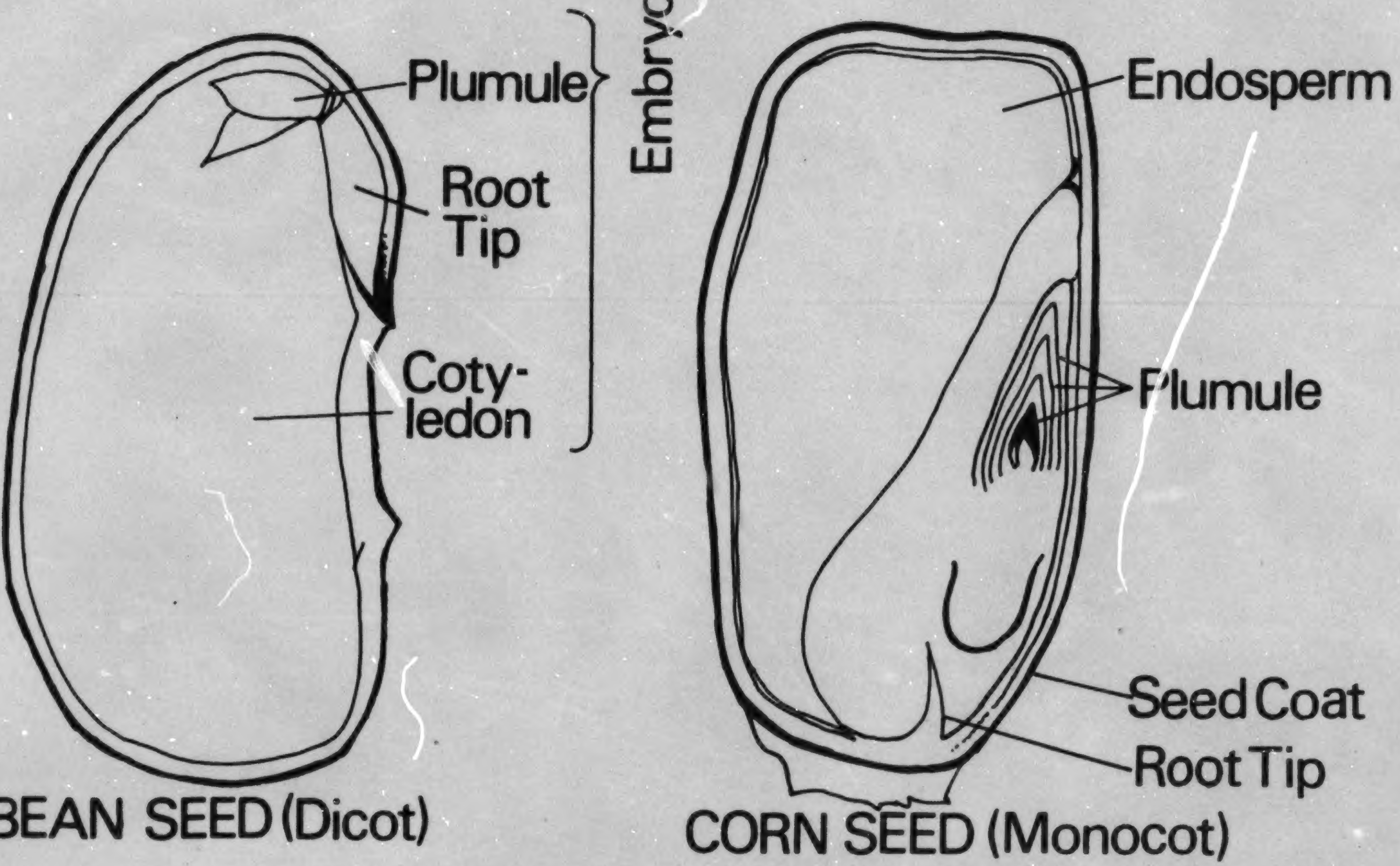
G. Depth of planting - If too deep, seed will use all stored food before it gets to the soil surface to manufacture its own supply. General rule is to plant the seed no deeper than three times the diameter of seed.

H. Dormancy - Due to an unfavorable environment.

Germination of Bean and Corn Seeds


Plumule
Cotyledon
Seed Coat
DICOT (Bean)
Plumule
First Internode
Primary Root
MONOCOT (Corn)

Views of Corn and Bean Seeds


Plumule
Root
Tip
Coty-
ledon
Embryo
Endosperm
Plumule
Seed Coat
Root Tip
BEAN SEED (Dicot)
CORN SEED (Monocot)

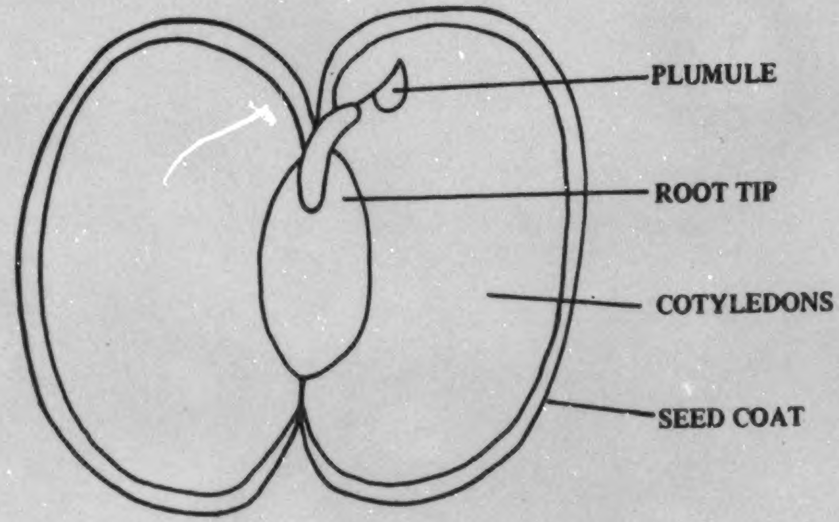
PLANT PROPAGATION

UNIT 2

JOB SHEET #1: Principal Parts of the Seed

I. Materials Needed:

- A. Bean Seeds
- B. Sharp knife
- C. Magnifying lens



II. Procedure:

- A. Remove the seedcoat and carefully split the bean down the middle to expose the embryo and cotyledons. Be sure to label your drawing as you locate each part.
- B. With the magnifying lens, carefully locate the embryo which is the dormant plant inside the seed. It consists of the cotyledons, plumule, and hypocotyl.
- C. After you have labeled the drawing, have your instructor check it for correctness.

PLANT PROPAGATION

UNIT 2

JOB SHEET #2: Factors Affecting Seed Germination

I. Materials Needed:

  A. Large seeds (sweet corn, pumpkins, beans)

  B. Five large-mouth glass jars

  C. Peat moss, vermiculite, wood shavings or sawdust

  D. Paper towels

II. Procedures:

  A. Line five large-mouth jars with paper towels

  B. Fill the jars with peat moss, vermiculite, wood shavings, or sawdust.

  C. Place some of the large seeds between the paper and the glass.

  D. Moisten the filling in three jars and add about one inch of water to the jars.

  E. Label one of these jars and place in a warm place.

  F. Label one jar and place in a refrigerator to show the effect of lower temperature.

  G. Label and tightly seal one jar and place it in a warm place to show the effect of lack of air. (Perhaps it would be good to use a jar which had been inverted over a burning candle to exhaust the atmospheric air supply first.)

  H. Fill one jar completely full of water to show the effect of too much water. Label and place in a warm place.

  I. Label and do not add any water to the fifth jar to show the effect of no water. Place in a warm place.

  J. After about ten days, observe what has happened to the seeds in each jar and record your findings.

PLANT PROPAGATION

UNIT 2

TEST

1. Match:

______a. Viability

______b. Variety

______c. Seed

______d. Embryo

______e. Endosperm

______f. Plumule

______g. Seed germination

1. Small, dormant plant inside the seed coat.
2. A ripened ovule.
3. Special food storage area for monocotyledonous seeds.
4. Process in which the embryo resumes growth.
5. Ability of a seed to be able to germinate.
6. A group of closely related plants of common origin which have similar characteristics.

2. List four factors upon which successful seed propagation depend.

3. Name two purposes of good seed propagation techniques.

4. State four reasons why plants are propagated from seeds.

5. List three main parts of a seed and one function for each.

6. Name one function of each of the following seed parts.

a. Seed coat

b. Monocot cotyledon

c. Dicot cotyledon

d. Plumule

e. Root tips

f. Endosperm

7. Name four factors affecting seed germination.

8. Indicate the correct sequence of steps in seed germination by placing numerals 1,2,3,4,5,6, and 7 in the appropriate blank.

______a. Seed swells and splits the seed coat.

______b. Seed coat softens and gets bigger.

______c. Primary root emerges through the split and grows downward to form the root.

TEST

_____d. Upper part of the epicotyl emerges from the soil.

_____e. Seed absorbs or soaks up water.

_____f. True leaves (plumules) unroll or unfold exposing the growth bud and allowing the plant to begin to grow.

_____g. Cotyledon (or cotyledons) open up above the ground.

9. Name five factors affecting viability of seeds.

10. Perform job in Job Sheet #1 to the satisfaction of the instructor.

11. Perform job in Job Sheet #2 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 3

SEEDING IN FLATS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terminology pertaining to seeding in flats. The student will select materials and sizes for flats; name the advantages of using flats; list ingredients in typical mixtures; and name the principal methods of sterilizing. The students will also state the advantages of starting seedlings indoors in flats; list factors involved in seeding in flats; state the information necessary on flat labels; and list the procedure to follow after the seeds have germinated in flats. This objective will be considered achieved upon successful completion of the jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to seeding in flats.
2. List three materials of which flats can be made.
3. List four advantages of the use of flats in propagating plants.
4. Name four key words describing an ideal medium for flats.
5. Name three typical mixtures of media for flats.
6. Name three methods of sterilizing media mixture.
7. List at least four advantages of starting seedlings indoors in flats.
8. Name five factors involved in seeding in flats.
9. Name three kinds of information that should appear on the label of a flat after it has been planted.
10. State the procedure to follow after the seeds have germinated in the flats.
11. Build a flat, given the materials. (Job Sheet #1)
12. Plant in a flat, given the materials. (Job Sheet #2)

PLANT PROPAGATION

UNIT 3

INFORMATION SHEET

I. Terms and Definitions:

- A. Peat - A substance consisting of partially carbonized vegetable material, chiefly mosses, usually found in bogs.
- B. Vermiculite - An inert (chemically inactive) material consisting of heat-treated mica that holds moisture.
- C. Perlite - A heat-treated material, like pumice, made of limestone.
- D. Broadcast - To distribute at random.
- E. Dolomitic Limestone - A fertilizer consisting of calcium magnesium carbonate.
- F. Ammonium Nitrate - A chemical essential for plant growth consisting of 33-½% nitrogen (NH_4NO_3).
- G. Ammonium Sulphate - A fertilizer with 22% nitrogen ($(NH_4)_2SO_4$), usually labeled "21-0-0 ".
- H. 5-10-5 - A complete chemical fertilizer consisting of 5 parts nitrogen (N), 10 parts phosphorus (P), and 5 parts potassium (K).
- I. Super-Phosphate - Calcium hydrogen phosphate and calcium sulphate in powder form, to be mixed with fertilizer.
- J. Hot Bed - A covered frame heated with manure or other heat source.
- K. Greenhouse - A building with transparent roof and sides in which plants are grown.
- L. Coldframe - A frame covered but not heated except by exposure to sun, for the purpose of protecting young plants outdoors.
- M. Seed Treatment - Treating seed with fungicide.

II. Flats:

- A. Flats are shallow trays made of wood, plastic, or metal with drainage holes in the bottom.
- B. Flats can be of many sizes. A frequent range of size is from 11" x 20" x 2½" to 14½" x 22½" x 3½".

III. Advantages of Using Flats in Propagating Plants

- A. Flats are light in weight and easily moved.
- B. Flats help keep crop-growing operation on schedule.
- C. Flats make the transplanting of seedlings easier.
- D. Flats make better use of the hot bed, greenhouse, and coldframe space.

INFORMATION SHEET

IV. Characteristics of an Ideal Propagating Medium for Seeding in Flats

A. Should be porous; i.e., should allow good aeration and hold sufficient moisture for plant growth, yet permit excess water to drain away.

B. Should be sterile; i.e., should be free of all harmful organisms and toxic materials.

C. Should be nutritious; i.e., should supply adequate nutrients to the seedling during all stages of the seedling's growth.

D. Should be lightweight.

V. Some Typical Mixtures of Media for Seeding in Flats

A. Soil-Peat-Sand - 2 parts soil - 2 parts peat - 1 part sand; or 1 part each.

B. Soil-Peat - Equal parts.

C. Peat (No. 4) or Vermiculite - Requires addition of super phosphate, dolomitic limestone, and ammonium nitrate to be effective.

D. Jiffy Mix, Redi-Earth, or other commercial mixtures - Require addition of super phosphate, dolomitic limestone, and 5-10-5.

VI. Methods of Sterilizing Media Mixtures (See TM 1)

A. By steam.

B. By chemicals.

C. By electricity.

D. A temperature of 180° for 30 minutes will sterilize a medium.

E. Further treatment may be required to neutralize buildup of certain chemicals during sterilization.

VII. Advantages to Starting Seedlings Indoors in Flats

A. Most economical use of small and expensive seeds.

B. Best for seeds that take a long time to germinate and grow.

C. Eases the potting of plants.

D. Eases the starting of later plants for summer production.

E. Enables plant growth to begin earlier.

F. Results in higher germination percentage.

G. Helps reduce loss from disease, insects and other unfavorable conditions.

INFORMATION SHEET

VIII. Factors Involved in Seeding in Flats

- A. Sterility of the medium - to prevent growth of unwanted bacteria.
- B. Spacing of seeds in flat - should be seeded by rows.
- C. Covering - Should not exceed twice the diameter of the seed.
- D. Watering
  - 1. After seed is planted and covered, water gently with a fine mist.
  - 2. Cover the flat with burlap bagging, glass, or plastic bag.
  - 3. No more water should be needed until germination takes place.
- E. Aeration
  - 1. After germination remove cover.
  - 2. Prevents damping-off.
  - 3. Prevents seedling from growing spindly.

IX. Information That Should Appear on Seed Flat Labels

- A. Name of plant and variety
- B. Date seeded
- C. Special treatment (if any)
- D. Write with water proof material

X. Procedure After Germination in Flats

- A. Remove cover (bag, glass, etc.)
- B. Place in cooler area. Usually 10° cooler than germinating temperature.
- C. Place in adequate sun
- D. Have good aeration
- E. Keep on the dry side

Killing Time for Various Soil Organisms when using Steam Sterilization (or "Pasteurization")

Organism	Time to Kill	Temperature
Nematodes	Instantly	140° F.
Soil Insects	Instantly	140° F.
Soil Fungi	10 minutes	140° - 160° F.
Soil Bacteria	10 minutes	140° - 160° F.
Weed Seeds	10 minutes	140° - 160° F
Soil Virus	30 minutes	180° F.

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PLANT PROPAGATION

UNIT 3

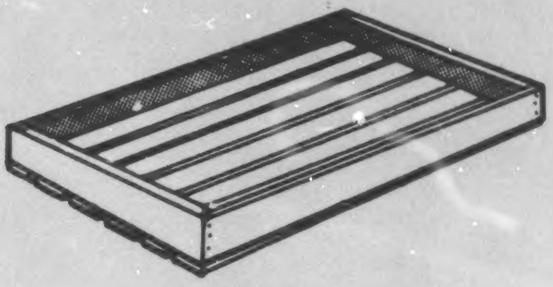
JOB SHEET #1: Building a Flat.

I. Materials Needed:

- A. One 1" by 4" board 7 feet long.
- B. One ½" by 3" board 51 inches long.
- C. Nails
- D. Hammer
- E. Framing square.
- F. Saw
- G. Wood preservative.

II. Procedure:

- A. Cut two 1" by 4" pieces 25" long for the sides of the flat.
- B. Cut two 1" by 3" pieces 16" long for the ends of the flat.
- C. Cut six ½" by 3" pieces 25" long for the bottom of the flat.
- D. Nail the sides to the ends to form the sides of the flat as follows:



- E. Square the corners of the flat with a framing square.
- F. Fasten the bottom of the side and end pieces. Leave at least 1/8" space between each board as you nail on the bottom. This space is for drainage.

PLANT PROPAGATION

UNIT 3

JOB SHEET #2: Starting Plants in Flats for Transplanting.

I. Materials Needed:

A. One flat.

B. Germination medium.

C. Seeds to be supplied.

D. One 2" by 4" block that will fit inside the flat.

E. Fungicide (a chemical that will kill fungus).

II. Procedure:

A. Fill the flat within ½" of the top with the germinating medium.

B. Firm lightly with a 2" x 4" block or brick.

C. Make rows ¼" deep and 1½" apart in the germinating medium.

D. Open the seed packet and put a small amount of fungicide in the packet with the seed. Close the hole and shake so all seeds will be coated with the fungicide.

E. Sow the seeds in the medium. Cover lightly.

F. Moisten and place in a warm place. You may cover the flat with glass, burlap or a plastic bag. (Instructor will decide) Check the flat several times and water as needed.

G. Fill out label.

NOTE: These seedlings will be transplanted in Unit 5.

PLANT PROPAGATION

UNIT 3

TEST

1. Match:

______a. Super-phosphate

______b. Vermiculite

______c. Peat

______d. Broadcast

______e. Dolomitic limestone

______f. Ammonium nitrate

______g. 5-10-5

______h. Hot bed

______i. Greenhouse

______j. Coldframe

1. Seeding at random.
2. Calcium magnesium carbonate (Fertilizer)
3. A chemical essential for plant growth.
4. A substance of partially carbonized vegetable material, chiefly mosses.
5. An inert material consisting of heat-treated mica.
6. A complete fertilizer (chemical) containing 5 parts nitrogen (N) 10 parts phosphorus (P), 5 parts potassium (K).
7. Fertilizing material mostly consisting of soluble phosphate.
8. A frame covered but not heated artificially.
9. A building with a transparent roof and sides in which plants are grown.
10. A frame covered and heated.

2. List three materials that flats are made of.

3. List four advantages of using flats in propagating plants.

4. Name four key words describing an ideal medium for seeding in flats.

5. List three typical mixtures of media for seeding in flats.

6. Name three methods of sterilizing media mixture.

7. List at least four advantages for starting seedlings indoors in flats.

8. List five factors involved in seeding in flats.

9. The label on the flat after it has been seeded should contain:

TEST

10. The procedure to follow after the seeds have germinated in the flats should be:

    a.

    b.

    c.

    d.

    e.

11. Perform job in Job Sheet #1 to the satisfaction of the instructor.

12. Perform job in Job Sheet #2 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 4

SEEDING IN THE FIELD

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to seeding in the field; to name characteristics of a good seed bed, factors determining the depth to which seed should be planted, and the selection of high quality seeds. The student will also be able to state the information required on a seed label; to name methods of seeding in the field; to state advantages of the use of mulches after seeding, and to list both organic and inorganic mulches. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

Upon completion of this unit, students will be able to:

1. Define terms pertaining to direct seeding in the field.
2. List four characteristics of a good seed bed.
3. Name three factors determining the depth to which a seed should be planted.
4. List five factors to consider in selecting high quality seeds.
5. Name three kinds of seeds that are available commercially.
6. List the information that is required on a seed label.
7. Name two methods of direct seeding in the field.
8. State four advantages to the use of mulches after seeding.
9. List four organic type mulches and three inorganic mulches.
10. Name five characteristics on which mulch selection is based.

PLANT PROPAGATION

UNIT 4

INFORMATION SHEET

I. Terms and Definitions

- A. Direct seeding - Sowing the seeds into the permanent location where the plants will grow and mature.
- B. Mulch - Any material placed about the stalks of plants to protect the roots and holds moisture, controls weed, controls the temperature and lengthens growing season.
- C. Seed Certification - A system used to keep pedigree records for crop varieties and to make available sources of genetically pure seed and propagating materials for general distribution.
- D. Plant pest - Any plant, disease, or animal that causes injury to a crop plant.
- E. Variety - The word that denotes plants that are closely related and of common origin and have similar characteristics.
- F. Cultivar - synonym for variety.
- G. Inert - Having no active chemical properties.

II. Characteristics of a Good Seed Bed

- A. Provides good aeration
- B. Has good moisture relationship
- C. Provides good seed contact with soil particles
- D. Is free of trash
- E. Is loose but not cloddy
- F. Is level

III. Depth at Which Seed Should Be Planted

- A. Depends on type of seed.
- B. Depends on size of seed
- C. Depends on moisture supply

IV. Factors to Consider in Selecting High Quality Seeds

- A. Color of seed coat
- B. Size and plumpness of seed
- C. Freedom from disease
- D. Freedom from broken seeds and noxious weeds
- E. Freedom from insects
- F. Viable seeds
- G. Seeds of good heritage

INFORMATION SHEET

V. Grades of Seeds Available Commercially

A. Registered seed - A new variety direct from the originator or from previously registered seed (See TM 1).

B. Certified seed - The bulk of improved seed for sale for commercial growing.

C. Foundation seed - The highest quality seed that can be purchased primary seed source of any plant variety.

D. Pure line seed - The result of multiplying purity percentage by germination percentage; i.e., a seed lot with 90% purity and 80% germination would have 72% (90x80 = 7200) pure live seed.

VI. Information Requirement on a Seed Label (See TM 1)

A. Kind, variety, and origin

B. Lot number

C. Percentage of purity

D. Percentage of inert matter

E. Percentage of weed seed

F. Percentage of other agricultural seeds.

G. Percentage of germination

H. Date of test

VII. Methods of Direct Seeding in the Field

A. By hand (Expensive and tedious)

B. By machinery

VIII. Advantages of Mulching After Seeding

A. Aids in conserving moisture

B. Provides an insulating effect

C. Aids in controlling weeds

D. Adds to the soil organic material

E. Adds nutrients to the soil

F. Aids in controlling soil erosion

INFORMATION SHEET

IX. Types of Mulches That Can be Used Effectively

- A. Organic Types
  - 1. Shredded bark
  - 2. Peat moss
  - 3. Straw
  - 4. Leaves
  - 5. Wood chips
  - 6. Corn cobs
  - 7. Paper
- B. Inorganic Types
  - 1. Black plastic sheet
  - 2. Stones and pebbles
  - 3. Aluminum foil
  - 4. Shredded plastics

X. Factors in Selecting Mulches.

- A. Availability
- B. Appearance
- C. Effect on the soil
- D. Acidity of its reaction
- E. Rate of decompostion
- F. Weed content
- G. Disease hazard
- H. Fire hazard

Seed Label Requirements

KIND	VARIETY	LOT NO.
ORIGIN		
PURITY %	WEED SEED %	INERT MATTER %
OTHER CROP SEED %		GERM DATE
GERMINATION		HARD SEED %

NAME AND NO. NOXIOUS WEEDS PER OZ.

VENDOR

ADDRESS

PLANT PROPAGATION

UNIT 4

ASSIGNMENT SHEET #1: Trip to a Local Feed Store

1. Each student is to visit a local seed store and copy three labels of three types of seed.

   A. Certified Seed

   B. Foundation Seed

   C. Registered Seed

   D. Uncertified Seed

PLANT PROPAGATION
UNIT 4
TEST

1. Define:
   a. Mulch
   b. Direct seeding
   c. Seed certification
   d. Noxious weed

2. List four characteristics of a good seed bed.

3. Name three factors determining the depth that the seed should be planted.

4. List five factors to consider in selecting high quality seeds.

5. Name three grades of seed that are available commercially.

6. List the information that is required on a seed label.

7. Name two methods of direct seeding in the field.

8. State four advantages to the use of muches after seeding.

9. List four organic mulches and three inorganic mulches.

10. Name five characteristics that mulch selection is based on.

PLANT PROPAGATION

UNIT 5

CARE AND TRANSPLANTING OF SEEDLINGS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terms pertaining to the care and transplanting of seedlings; to list the types of containers available, and how to select them. The students will be able to demonstrate procedures to follow before and after transplanting and will be able to state the process by which plants are hardened and the reason why. This objective will be considered achieved upon successful completion of the jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define the terms, hardening and transpiration.
2. Name four considerations in the care of seedlings before transplanting.
3. List four types of pots available for transplanting.
4. Name four factors to consider when selecting plant containers.
5. Select from given statements those that are rules to follow when transplanting seedlings.
6. List the steps to follow after transplanting.
7. Name the process by which plants are hardened.
8. Transplant a seedling properly. (Job Sheet #1)

PLANT PROPAGATION

UNIT 5

INFORMATION SHEET

I. Terms and Definitions

A. Hardening - Subjecting plants to harsher conditions to prepare them to withstand the severe shock of transplanting outside.

B. Transpiration - Loss of water from plant parts in vapor form.

II. Care of Seedlings Before Tranplanting

A. Amount of Watering.

1. Amount of watering depends upon the temperature and amount of sunlight each day.

    a. If day is relatively cloudy and cool, less water is required.

    b. If day is sunny and hot, more water is required.

2. A good rule of thumb is to water just enough so that soil will be dry before dark.

B. Temperature Control

1. For plants that require cooler temperatures (e.g., cabbages, snapdragons), temperature should be constantly between 50 and 55 at night and 60 and 70 in day.
2. For plants that require warmer temperatures (e.g., tomatoes, marigolds, petunias), temperature should be constantly between 55 and 60 at night and 70 in day.
3. In either case, temperature should be as constant as possible.

C. Light Control

1. Too much light on a seedling will burn and damage foliage. Varies according to kind of plant.
2. Too little light on a seedling causes plant to grow thin and spindly as it "reaches" for more light. Varies according to kind of plant.

D. Disease Control

1. Disease can be prevented by using proper medium.
2. Disease can be prevented by sterilizing medium.
3. Disease can be prevented by using disease-free seeds.
4. Disease can be prevented by watering properly.
5. Disease can be prevented by controlling temperature properly.

INFORMATION SHEET

6. Disease can be prevented by lighting properly.
7. Disease can be prevented by proper spacing when seeding.
8. Disease can be prevented by adequate air movement.

III. Types of Pots Available for Transplanting

A. Plastic - Requires 1/3 less water than clay pots; fertilizer won't seep through pot.

B. Clay - Has more seepage and aeration through sides; sometimes allows growth of fungus.

C. Plant bands - Made of wood or tar paper.

D. Peat pots - Made of 75% peat moss and 25% virgin wood fiber. These should not be removed when seedling is transplanted.

E. Mache - made of compressed paper.

IV. Factors to Consider When Selecting Plant Containers

A. The propagator's needs and desires

B. Cost of container

C. Economy of use

D. Strength of container

E. Absorption quality

F. Appearance of plant in container

G. Customer acceptance

V. Some Rules for Transplanting Seedlings

A. Transplant as soon as possible after the first true leaves appear.

B. Handle seedlings by the leaves.

C. Keep partially shaded for the first few days after transplanting and hold at a cool temperature.

D. Water through a nozzle that produces a fine mist so the seedling will not wash out.

E. Fertilize once a week with two tablespoons of 20-20-20 (i.e., 20 parts nitrogen, 20 parts phosphates, 20 parts potassium) per two gallons of water.

INFORMATION SHEET

VI. Procedures to Follow After Transplanting

A. For three to four weeks grow the transplanted seedlings at 60°F.

B. For the next two or four weeks grow the seedlings at 40°F (or in a cold frame kept well above freezing - lower temperatures helps in producing stronger, stockier plants.)

C. Water and fertilize as instructed in V. (Some Rules for Transplanting Seedlings)

VII. Hardening Plants for Transplanting Outside

A. Plants that are started in flats to be transplanted out of doors should first be transplanted from the flat to a larger container indoors to encourage better individual growth.

B. Purposes of the hardening process:

1. To prepare the plant to withstand cooler temperatures.
2. To increase plant establishment under adverse conditions when it is transplanted outdoors.

C. The process by which plants are hardened is:

1. Gradually reduce the amount of watering a plant receives.
2. Gradually reduce the temperature to that in which the plant will be permanently placed.
3. This process should continue for one to two weeks.

PLANT PROPAGATION

UNIT 5

ASSIGNMENT SHEET #1: Garden Shop Visit

I. Visit a local garden shop or nursery and find out the advantages and disadvantages of the following containers, filling out this table. Instructor will evaluate.

	ADVANTAGES	DISADVANTAGES
a. Plastic		
b. Clay		
c. Plant bands		
d. Peat pots		
e. Any other		

PLANT PROPAGATION

UNIT 5

JOB SHEET #1: Transplanting Seedlings From the Seed Flat to Suitable Containers

I. Equipment and Materials Needed:

  A. One flat of seedlings (HORTII SC U3-8 Job Sheet #2)

  B. Suitable medium

  C. Suitable containers

II. Procedure:

  A. Prepare the medium into which the plants are to be transplanted.

  B. Fill the container to within ½ inch of the top. Level off the surface.

  C. Mark rows and poke holes in the medium of a size that will accommodate the plants. The holes should be spaced from two to four inches apart each way.

  D. Carefully lift the seedlings by the leaves from the germinating medium. Do not transplant weak, damaged, or malformed seedlings.

  E. Place the roots in the holes and press the soil firmly around the root system with the thumbs and index fingers to eliminate air pockets. Be careful that the planting of the seedlings is neither too deep nor too shallow.

  F. Thoroughly water the flats or containers, taking care that the seedlings are not washed out by the force of the water.

  G. Place the transplanted seedlings in a shaded area and hold them at a cool temperature. Keep them moist for a few days until they have become re-established.

PLANT PROPAGATION
UNIT 5
TEST

1. Define:
   a. Hardening
   b. Transpiration

2. Name four considerations in the care of seedlings before transplanting.

3. List four types of pots available for transplanting.

4. Name four factors to consider when selecting plant containers.

5. Select from the following those statements that are rules to follow when transplanting seedlings.
   ______a. Keep in a dark place.
   ______b. Transplant as soon a possible after first true leaves appear.
   ______c. Fertilize with 5-10-5 once a week.
   ______d. Fertilize with 20-20-20 once a week.
   ______e. Water directly from the tap.
   ______f. Water with a fine mist.
   ______g. Keep partly shaded for first few days at a cool temperature.

6. List the steps to follow after transplanting.
   a.
   b.
   c.

7. State the steps in the process by which plants are hardened.
   a.
   b.
   c.

8. Perform job in Job Sheet #1 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 6

INTRODUCTION TO ASEXUAL PLANT PROPAGATION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to differentiate between sexual and asexual propagation, identify terms that pertain to asexual plant propagation, and to list different methods of asexual propagation and reasons for using these methods. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define sexual and asexual propagation.
2. Match terms pertaining to asexual propagation.
3. List five methods of asexual (vegetative) propagation.
4. Name five reasons for using asexual (vegetative) propagation.
5. Name three cuttings that require leaves and two cuttings that do not require leaves.
6. List five main types of propagating by layering and three requirements for all types of layering.
7. Choose words that make a statement concerning the process of propagating by division a true statement, and state at least one reason this method is used.
8. Name two methods of propagating by budding.
9. List two recognized types of grafting.

UNIT 6

INFORMATION SHEET

I. The Principal Difference Between Sexual and Asexual Propagation.

- A. Sexual propagation is the controlled reproduction of plants by use of seeds.
- B. Asexual propagation is the controlled reproduction of plants by using a part of the growing plant or specialized stem or root growth of the plant.

II. Terms and Definitions.

- A. Cutting - The process of propagating plants by the use of vegetative parts which when placed under suitable conditions will develop into complete plants.
- B. Layering - Propagation of plants from parts that remain attached to the parent plant while rooting.
- C. Division - Dividing a clump of plants into smaller sizes.
- D. Budding - A special type of grafting using a single bud inserted into the bark of another variety.
- E. Grafting - Method of inserting buds, twigs, or shoots on other stems or roots of other plants.
- F. Vegetative - Part of the already growing plant that is used for reproduction (another term for asexual).
- G. Stolon - A trailing branch that develops
- H. Adventitious roots - are formed without order or in unusual places.
- I. Node - The joint or knob on the stem of a plant, from which leaves, buds, or other structures grow.
- J. Internode - The part of a plant stem between the nodes.
- K. Stock Plants - Plants from which vegetative parts are taken and used for asexual propagation.

III. Methods of Asexual Propagation (Vegetative).

- A. Cuttings
- B. Layering
- C. Division
- D. Budding
- E. Grafting

INFORMATION SHEET

IV. Reasons for Asexual (Vegetative) Propagation.

A. Plants propagated asexually will have the same genetic makeup of the parent plant.

B. Asexual propagation makes production of a standardized high-quality product possible.

C. Without sexual propagation some valuable plants would be lost.

D. Certain valuable plants produce little or no seed (e.g., bananas, seedless grapes, navel oranges, flowering cherry, flowering almond, and gardenia) and can be propagated only by asexual means.

E. Other plants produce seed which germinates with difficulty (e.g, holly, roses, and some viburnums); therefore, these can be more effectively propagated by asexual means.

F. Some plants are more resistant to diseases, others are more resistant to nematodes (e.g., certain species of European grapes are resistant to the root louse and certain species of the peach are resistant to nematodes) and asexual propagation preserves these resistances.

G. Some plants are more vigorous when they are grafted on roots of related kinds (e.g., certain species of the labrusca grape impart vigor to the tops.)

H. Some plants are propagated more economically by asexual (vegetative) means (e.g., strawberry, blueberry, and potato).

V. Asexual (Vegetative) Propagation by Cuttings.

A. Cuttings which require leaves:

1. Herbaceous stem cuttings (e.g., chrysanthemum, geranium, coleus, carnation).
2. Leaf and bud cuttings (e.g., saintpualia, begonia, gloxinia).
3. Softwood cuttings (e.g., dogwood, spirea, azalea, holly, juniper).
4. Leaf cuttings (e.g., saintpaulia, begonia, pepperomia).

B. Cuttings which do not require leaves:

1. Deciduous hardwood cuttings (e.g., fig, current, grape, gooseberry).
2. Root cuttings (e.g., blackberry, wisteria, bouvardia).

VI. Asexual (Vegetative) Propagation by Layering

A. The main types of propagating by layering are:

1. Tip
2. Simple
3. Trench

INFORMATION SHEET

4. Mound
5. Air

B. Requirements for all types of layering are:

1. Adequate oxygen and moisture
2. Exclusion of light
3. Use of young wood

VII. Asexual (Vegetative) Propagation by Division

A. The process of propagating by division is digging up the plant, dividing it, and then replanting.

B. Reasons plant division is used

1. If not divided, the plant becomes so crowded that production will reduce.
2. Some plants can be propagated best by division (e.g., daylilies, iris, garden chrysanthemums, geraniums, sansevieria.)
3. Some stems can be propagated only by division (e.g., rhizomes, stem tubers, tuberous roots, bulbs, corms, stolons, etc.)

VIII. Asexual (Vegetative Propagation by Budding)

A. Budding is a form of grafting

B. Methods of Budding

1. T-budding (also called shield budding)
2. Patch budding
    a. I-bud
    b. Flute bud
    c. Ring bud

IX. Asexual (Vegetative Propagation by Grafting)

A. Two recognized types of grafting

1. Budding - Consists of uniting a vegetative but to a seedling plant or to a mature plant.
2. Grafting - Consists of uniting a piece of twig with two or more vegetative buds to a seedling plant or to a mature plant.

HORTII SC U6-6

PLANT PROPAGATION

UNIT 6

TEST

1. Show knowledge of the difference between sexual and asexual propagation by defining each.

2. Match:

______a. Cutting
______b. Layering
______c. Division
______d. Budding
______e. Grafting
______f. Vegetative
______g. Stolon
______h. Adventitious roots
______i. Node
______j. Internode

1. The part of a plant stem between the nodes.
2. The joint or knob on the stem of a plant, from which leaves, buds or other structures grow.
3. Roots formed without order or in unusual places.
4. A trailing branch that takes root and forms a new plant.
5. Part of the already growing plant that is used for reproduction (another term for asexual)
6. Method of inserting buds, twigs, or shoots on other stems or roots of other plants.
7. A special type of grafting using a single bud inserted into the bark of another variety.
8. Dividing a clump of plants into smaller sizes.
9. Propagation of plants from parts that remain attached to the parent plant while rooting.
10. The process of propagating plants by the use of vegetative parts which when placed under suitable conditions will develop into complete plants.

3. List five methods of asexual (vegetative) propagation.

4. Name five reasons for using asexual (vegetative) propagation.

5. a. Name three cuttings that require leaves.
   b. Name two cuttings that do not require leaves.

6. a. List five main types of propagating by layering.
   b. List three common factors concerning all types of layering.

TEST

7. a. The process of propagating by ________________ is digging up the plant, ____________________ it and then replanting.

   b. Name three reasons why propagation by division is used.

8. Name two methods of budding.

9. List two recognized types of grafting.

PLANT PROPAGATION

UNIT 7

PROPAGATION BY CUTTINGS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to propagation by cuttings; to list treatments to cuttings before enabling them to root; to name kinds of wounding; to answer questions about the use of hormones; to name cuttings that do not require leaves; and to name the reasons for storage and callusing. This objective will be considered achieved upon successful completion of the jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to propagation by cuttings with their definitions.
2. List three treatments to cuttings before placing them in rooting medium.
3. Name three basic kinds of wounding.
4. Answer correctly given questions concerning the use of hormone treatment of cuttings.
5. Select from given statements about storage and callusing which are true and which are false.
6. List three cuttings that require leaves.
7. List two cuttings that do not require leaves.
8. Make light, heavy, and layerage wounds on given cuttings. (Job Sheet #1)
9. Give a hormone treatment to a cutting. (Job Sheet #2)
10. Store and callus given cuttings. (Job Sheet #3)
11. Demonstrate propagation of given herbaceous stem cutting. (Job Sheet #4)
12. Demonstrate leaf-bud cutting. (Job Sheet #5)
13. Demonstrate a root cutting. (Job Sheet 6)

PLANT PROPAGATION
UNIT 7
INFORMATION SHEET

I. Terms and Definitions

   A. Dormant Season - Period during which no visible growth occurs because of unfavorable conditions.

   B. Laterals - Growth from side branches.

   C. Rooting hormone - A natural occuring or a synthetic compound which is used to stimulate root initiation.

   D. Callusing - Hardwood cuttings stored at a cool temperature to break the bud dormancy and to begin initiation of roots.

   E. Wounding - Cutting of a stem, lightly, heavily, or for layering depending upon the purpose.

   F. Herbaceous - The adjective that applies to plants that are like an herb; having stems that are unusually soft and not woody.

   G. Deciduous - The adjective that applies to trees or shrubs that shed their leaves each year.

II. Three Treatments for Cuttings Before Placing Them in Rooting Media

   A. Wounding

   B. Hormone Treatment

   C. Storage and Callusing

III. Three Basic Kinds of Wounding (See Job Sheet #1)

   A. Light

   B. Heavy

   C. Layerage

IV. Hormone Treatment (See Job Sheet #2).

   A. Cuttings are treated with a hormone immediately after wounding.

   B. Cuttins are treated with a hormone to increase the percentage of cuttings that will root by hastening root initiation.

   C. The most common rooting hormone used is indolebutryic acid (IBA).

V. Storage and Callusing (See Job Sheet #3)

   A. Hardwood cuttings are stored in moist peat moss at 40°F.

   B. Hardwood cuttings are stored at a cool temperature in order to break bud dormancy and to begin root initiation.

   C. Callus tissue is formed on cutting ends.

INFORMATION SHEET

VI. Cuttings That Require Leaves

A. Herbaceous stem cuttings (See Job Sheet #4).
Examples: Chrysanthemums, coleus, carnations, geraniums.

B. Leaf and leaf bud cutting (See Job Sheet #5).
Examples: Saintpaulia (African violet), begonia, gloxinia, pepperomia.

C. Softwood cuttings (from both deciduous and evergreen woody plants) (See Job Sheet #4).
Examples: Dogwood, spirea, azalea, holly, rose, euonymus, pyracantha, yew.

VII. Cuttings That Do Not Require Leaves

A. Deciduous hardwood (See Job Sheet #3).
Examples: Fig, current, grape, gooseberry, mock orange, forsythia.

NOTE: These cuttings should be allowed to grow for a season or two before transplanting.

B. Root Cuttings (See Job Sheet #6).
Examples: Blackberry, red raspberry, bouvardia, wisteria.

PLANT PROPAGATION

UNIT 7

JOB SHEET #1: Wounding

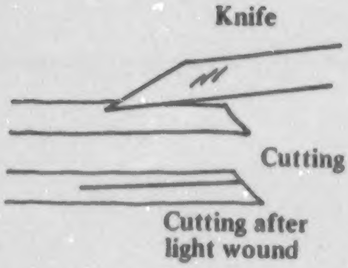
I. Equipment and Materials Needed:

- A. Sharp knife.
- B. Plant cuttings.

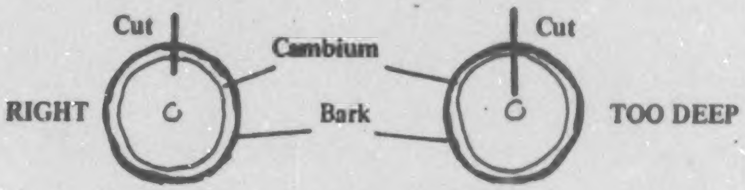
II. Procedure:

A. Light Wound

1. Lay the cutting on a flat surface.
2. Hold the cutting carefully in one hand and the sharp knife in the other.
3. Make the cut beginning 1-1½" from the bottom of the cutting and cut toward the butt end (see drawing).
4. Cut through the bark.

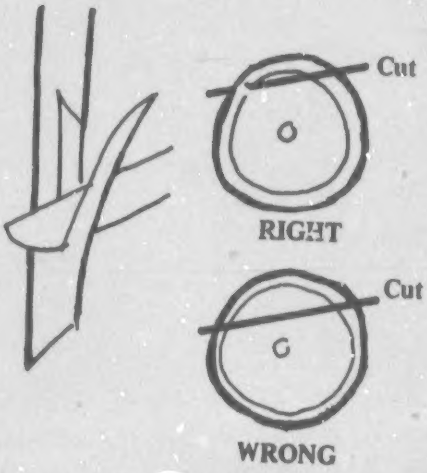


NOTE: The wound should be just deep enough to go completely through the bark and to the cambium layer beneath. Care is taken to see that the wound is not too deep. We do not want to cut right into the central portion of the stem (see drawing below).



B. Heavy Wound:

1. Hold the cutting carefully in one hand and a sharp knife in the other.
2. Make the cut beginning 1-1½" from the bottom of the cutting and cut toward the butt end (see drawing).
3. Cut just deep enough to remove a strip of bark. Don't cut into the woody layer (see drawing).

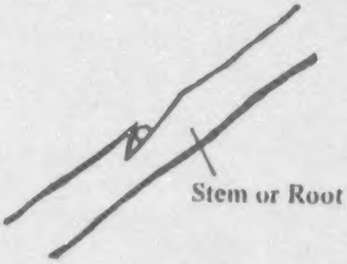


NOTE: If side branches are removed from evergreens by stripping them down the stem, the scars you leave on both sides of the stem will be wounds enough.

JOB SHEET #1: Wounding

C. Layerage wound (good for simple or air layer).

1. Hold the stem or root firmly and with a sharp knife make an angle cut about 1/3 of the thickness of the stem or root.
2. After making the wound, insert a small pebble or a match stick to keep it from sealing closed (see drawing).



PLANT PROPAGATION

UNIT 7

JOB SHEET #2: Hormone Treatments

I. Equipment and Materials Needed:

A. A commercially prepared rooting compound
B. A glass bottle
C. A paper cup
D. Cuttings
E. Rooting medium

II. Procedure:

A. Select a commercially prepared rooting compound.

NOTE: BE SURE TO FOLLOW THE DIRECTIONS WHICH THE MANUFACTURER PLACED ON THE HORMONE PACKAGE.

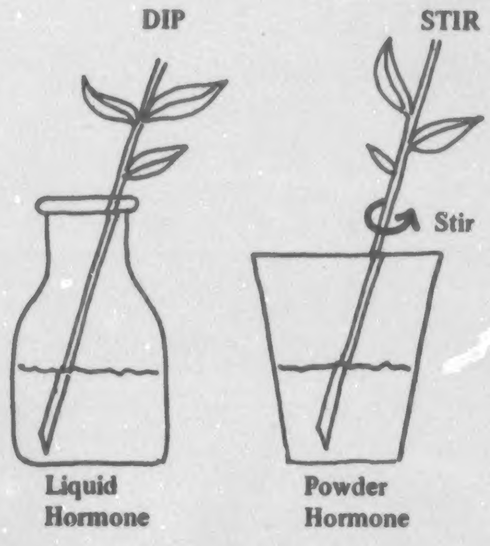
B. Wound the cutting (Job Sheet #1).

C. Immediately after wounding, dip the wounded portion into the hormone deeply enough to cover the entire wounded area.

D. After treating with a hormone the treated portion should not be touched but inserted immediately into the rooting medium.

E. For layerage the powdered hormone can be sprinkled into the wound.

NOTE: Hormones do not work at below 50°F.



PLANT PROPAGATION

UNIT 7

JOB SHEET #3: Layerage by Callusing

I. Equipment and Materials Needed:

  A. Wooden box
  B. Stem cuttings
  C. Peat moss
  D. Burlap sack
  E. Newspapers

II. Procedure:

  A. Select stem cuttings (only hardwood need to be callused before rooting).
  B. Wound the stem cuttings.
  C. Choose or build a tightly constructed wooden box that is big enough to hold the cuttings you wish to callus.
  D. Line the inside of the box with damp burlap
  E. Place 5 to 6 inches of damp peat moss in the bottom of the box.
  F. Tie the stem cuttings loosely together in bunches of 15 to 20 per bunch with twine.
  G. Lay these bunches of stem cuttings on top of the peat moss which you have placed in the bottom of the box.
  H. Cover the bunches of stem cuttings with 5 or 6 inches of damp peat moss.
  I. Press or pack the peat moss down on top of the stem cuttings.
  J. Place damp burlap sacks on top of the last layer of peat moss.
  K. Cover the top of the box with newspapers to keep the burlap and peat moss from drying out.
  L. Place the box in cold frame for three weeks.
  M. At the end of three weeks, the cuttings should have a milky-colored callus formed over the cut ends of the stem cuttings.
  N. Now the cuttings are ready to be placed in a rooting medium.
  O. Hardwood stem cuttings can be stored over winter by placing this box of cuttings in a cold frame until spring.

PLANT PROPAGATION

UNIT 7

JOB SHEET #4: Herbaceous Stem Cutting (Coleus).

I. Equipment and Materials Needed:

- A. One healthy cloeus plant.
- B. One sharp knife.
- C. One four inch clay pot.
- D. Rooting hormone.
- E. A dibble stick.
- F. Some sharp clean sand.
- G. Some horticultural peat.
- H. One one-quart jar, coat hanger and plastic, or other suitable covering.

II. Procedure:

- A. Mix enough peat and clean sand together to almost fill the four-inch clay pot. (50% sand and 50% peat by volume).
- B. Fill the clay pot with the sand-peat rooting medium and firm it with your fingers - do not pack it tightly.
- C. Choose a rapidly growing (new growth) stem from the coleus and from approximately the middle of the stem, cut a 3 to 5 inch section. This cut should be made just below a leaf node. (The stem tip may also be used.)

NOTE: BE SURE THE CUTTING YOU TAKE HAS AT LEAST TWO BUDS ON IT.

- D. Carefully remove all the leaves from the lower 1/3 of the cutting.
- E. Cut the top of the stem off square, unless the stem tip is being used, and angle the bottom of the stem approximately 45 degrees (see drawing at the bottom of second page).
- F. Now make a 1-inch light wound at the bottom of the stem (refer to Job Sheet #1).
- G. Dip the wounded portion of the stem into the rooting hormone deeply enough to cover the wounded area (refer to Job Sheet #2).
- H. With the dibble stick, poke a hole in the rooting medium that will be big enough to place the stem cutting approximately 1/3 of its length into the rooting medium.
- I. Place the stem cutting into the clay pot (1/3 of its length in the rooting medium) and press the medium firmly around it.
- J. Now soak the medium with water slowly until water starts running out of the hole in the bottom of the pot. This will settle the medium in around the stem for good stem-soil contact. Now

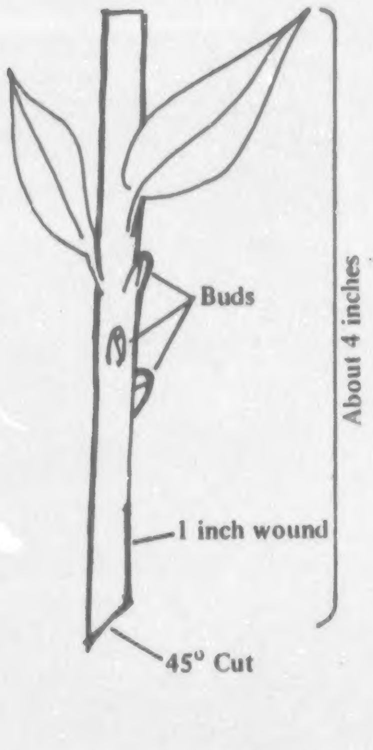
place a 1-quart glass jar over the cutting to seal in the moisture. This jar will need to be lifted every other day to let in fresh air. (On large-scale propagating benches use polyethylene film for this purpose.)

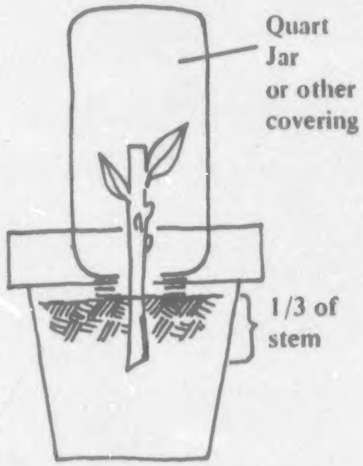
K. Place the stem cutting in the greenhouse where the temperature should remain about 70 degrees.

L. The cutting should be sprinkled lightly every few days to keep the rooting medium moist.

NOTE: OVER WATERING WILL CAUSE THE STEMS TO ROT AND UNDER WATERING WILL CAUSE IT TO DRY OUT AND DIE.

M. In two to five weeks, the cutting should be ready to transplant into a bigger pot. At the time of transplanting, note the root growth around the wounded area. (Several stem cuttings could be made and allowed to root for different lengths of time so you can observe the rate of root development.) Be sure to recheck the job sheet on transplanting when your stem cuttings are ready to be transplanted.





PLANT PROPAGATION

UNIT 7

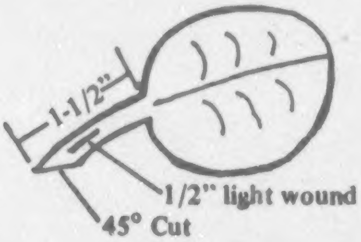
JOB SHEET #5: Leaf Cutting Using a Saintpaulia (African Violet)

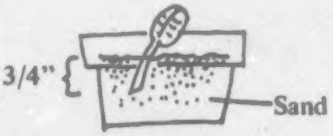
I. Equipment and Materials Needed:

- A. One healthy African violet plant.
- B. One sharp knife.
- C. One two-inch clay pot.
- D. Rooting hormone.
- E. A dibble stick.
- F. Some clean sharp sand.

II. Procedure:

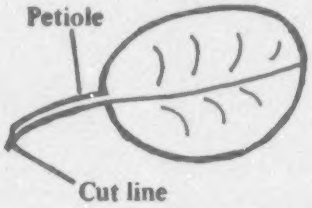
- A. Fill the two-inch clay pot almost full with clean, sharp sand.
- B. Pack the sand gently with your fingers.
- C. From the healthy African violet plant, select a vigorous looking leaf.





NOTE: The leaves selected for cuttings should neither come from the top nor the bottom of the plant.

- D. Remove the entire leaf and petiole carefully from the plant with your knife without harming the original plant (see drawing below).



- E. Now cut the leaf stem again at a 45° angle so approximately 1-1½ inch of the stem remains (see drawing after "C").
- F. Wound the leaf stem with a light wound of about 1/2 inch long. (See Job Sheet #1).

JOB SHEET #5: Leaf Cutting Using a Saintpaulia (African Violet)

G. Dip the wounded portion of the stem into the rooting hormone, deeply enough to cover the wounded portion.

H. With the dibble stick make a hole in the sand that is big enough for you to easily insert the leaf stem about 3/4 inch deep.

I. Place the leaf cutting into the dibble hole and gently pack the sand around it to cause it to stand erect.

J. Now with room-temperature water, soak the sand slowly until water starts running out of the hole in the bottom of the pot. This will settle the sand in around the stem for good sand-stem contact.

K. Place the leaf cutting in the greenhouse where the temperature should remain about 70 degrees.

L. The cutting should be watered every few days until water starts tc run out of the hole in the bottom of the pot.

NOTE: Care should be taken when watering not to get water on the leaf. Constant watering of the leaf surface will cause it to rot, "ring spot."

M. In three weeks the cutting should be ready to transplant into a bigger pot. At the time of transplanting note the root growth around the wounded area. (Several leaf cuttings could be made and allowed to root for different lengths of time so you can observe the rate of root development.) Be sure to recheck the job sheet on transplanting when your leaf cuttings are ready to be transplanted.

PLANT PROPAGATION

UNIT 7

JOB SHEET #6: Root Cuttings

I. Equipment and Materials Needed:

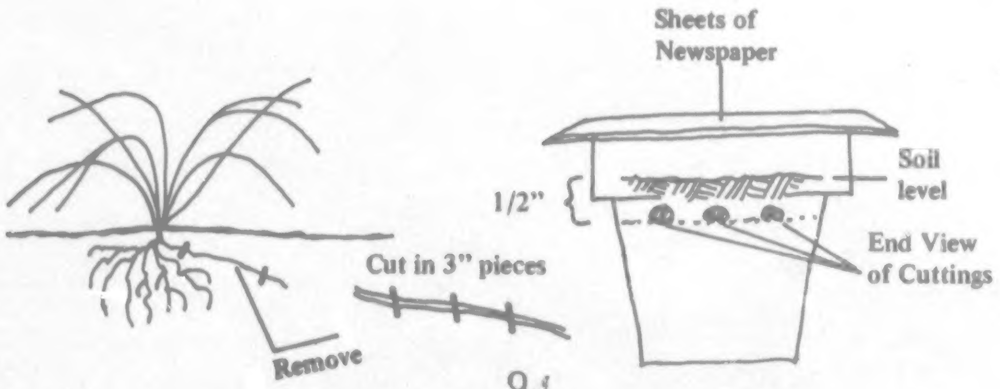
- A. A mature, growing brambleberry bush.
- B. A round pointed spade.
- C. A four-inch clay pot.
- D. Light garden loam soil.
- E. Some newspapers.

II. Procedure:

- A. Select a mature, healthy red raspberry bush (at least two years old).
- B. Carefully dig around the bush approximately one foot away until a lateral root is located.
- C. Cut the root from the plant about 8 to 10 inches away from the main root.

NOTE: The root selected should be at least 1/4 inch in diameter.

- D. Carefully dig up the rest of the root.
- E. Fill in the hole and pack the soil back around the plant with your foot.
- F. After removing the root you should now cut it into approximately three-inch sections. The cut should be made at a 45° angle. (Several root cuttings can be obtained from each root.)
- G. Fill a clay pot to within one inch of the top with the garden loam soil, and firm it with your fingers. Do not pack it tightly.
- H. Now place the cuttings two inches apart in a horizontal position on top of the soil (see drawing below.)



JOB SHEET #6: Root Cuttings

I. Cover the root with about 1/2 inch of additional soil.

J. Flood the clay pot with water so the rooting medium will settle in next to the root for good soil-root contact. Water should run out of the hole in the bottom of the pot.

K. After the water stops running from the hole in the bottom of the pot, cover with newspapers, and place the pot in the greenhouse where the temperature should remain about 70 degrees.

NOTE: Overwatering will cause the root to rot and underwatering will cause it to dry out and die. Just enough water should be added every few days to keep the surface of the rooting medium from drying out.

M. In about three weeks a green sprout should emerge. Remove the newspapers at this time. When this sprout develops to the three leaf stage, the plant should be transplanted and placed in the cold frame.

PLANT PROPAGATION

UNIT 7

TEST

1. Match:

______a. Rooting hormone

______b. Laterals

______c. Callusing

______d. Dormant season

______e. Wounding

______f. Herbaceous

______g. Deciduous

1. Describing plants with stems that are usually soft and not woody.
2. Describing trees on shrubs that shed their leaves each year.
3. Cutting a stem lightly, heavily, or for layering.
4. The storing of hardwood cuttings at a cool temperature to break the bud dormancy and to initiate roots.
5. Period during which no growth occurs because of unfavorable conditions.
6. Growth from side branches.
7. A natural-occuring or a synthetic compound which is used to stimulate root initiation.

2. List the three treatments which have to be made to cuttings before placing them in rooting medium.

3. Name three basic kinds of wounding.

4. a. When are cuttings treated with a hormone?

   b. Why are cuttings treated with a hormone?

   c. What is the most common rooting compound used? Give initials.

5. Indicate which of the following statements are true and which are false.

_____a. Hardwood cuttings are stored in dry peat moss at 40°F.

_____b. Hardwood cuttings are stored at a cool temperature in order to break bud dormancy and to begin root initiation.

_____c. Callus tissue is formed on cutting ends.

6. List three cuttings that require leaves.

7. List two cuttings that do not require leaves.

8. Perform job in Job Sheet #1 to the satisfaction of the instructor.

9. Perform job in Job Sheet #2 to the satisfaction of the instructor.

TEST

10. Perform job in Job Sheet #3 to the satisfaction of the instructor.
11. Perform job in Job Sheet #4 to the satisfaction of the instructor.
12. Perform job in Job Sheet # 5 to the satisfaction of the instructor.
13. Perform job in Job Sheet #6 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 8

PROPAGATION BY LAYERAGE

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to list the advantages and disadvantages of propagation by layerage, to name the different kinds of layerage, and to demonstrate in the laboratory and the field how to perform the various types of layerage. This objective will be considered achieved upon successful completion of jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Name two advantages of propagation by layerage.
2. Name two disadvantages of propagation by layerage.
3. Name six kinds of layerage including the one kind of above ground layerage.
4. List two points to consider when transplanting layerage plants.
5. Demonstrate propagation by tip layerage. (Job Sheet #1)
6. Demonstrate propagation by simple layerage. (Job Sheet #2)
7. Demonstrate propagation by air layerage. (Job Sheet #3)

PLANT PROPAGATION

UNIT 8

INFORMATION SHEET

I. Advantages of Propagation by Layerage

   A. Relatively dependable method of inducing rooting.

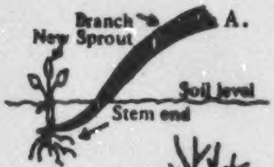
   B. Commonly used to propagate plants which are difficult to root.

II. Disadvantages of Propagation by Layerage

   A. Relatively expensive method of propagating.

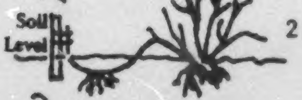
   B. Generally does not lend itself to the production of large number of plants.

III. Kinds of Layerage

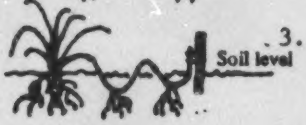


   A. Ground Layerage

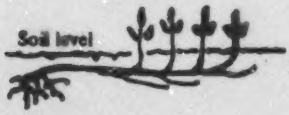
      1. Tip - (late August, early September) where the tip of a branch is placed one or two inches of soil and allowed to root. Examples: Trailing blackberries, dewberries, black and purple raspberries.



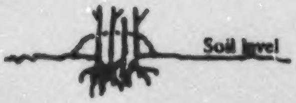
      2. Simple - (early spring using dormant one-year-old shoots) a portion of the stem is buried from three to six inches deep, leaving the growing tip exposed, and allowed to root.



      3. Compound or serpentine - (summertime) a stem is alternately covered and exposed, allowing it to root in more than one place. Examples: Wisteria, clematis, ivy, philodendron,

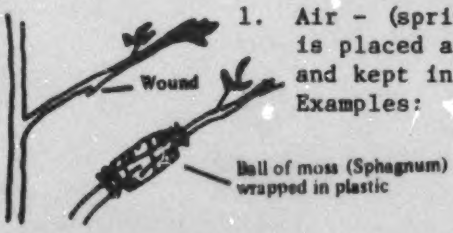


      4. Trench - (winter) entire plant (except the terminal tip) is bent over and covered.



      5. Mound - (winter) cutting back the stems of the plant during the non-growing season and covering the yound stems with a mound of soil. In the spring the stems have rooted and removed to make new plants.
      Examples: Currants, gooseberries, certain ornamental shrubs, quinces.

   B. Above ground layerage



      1. Air - (spring and summer) a rooting medium which is kept moist is placed around a previously prepared point on the limb and kept in place until roots develop.
      Examples: Croton, hibiscus, dracaena, rubber plant.

INFORMATION SHEET

VI. Transplanting Layerage Plants

A. Prune vegetative growth so that it stays in keeping with the size of new roots.

B. Remove plant from parent plant and handle the same as a rooted cutting.

PLANT PROPAGATION

UNIT 8

JOB SHEET #1: Propagation by Tip Layerage

I. Equipment and Materials Needed:

A. A healthy, mature, brambleberry bush.

B. A round point spade.

C. One 12 inch piece of number 9 wire.

D. Some rooting hormone.

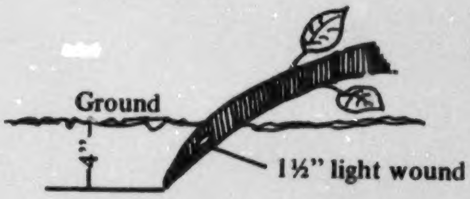
E. Some horticulture peat.

F. A dibble stick.

II, Procedure:

A. This job should be done at the start of the growing season.

B. Select a healthy, mature, red raspberry bush (2 or 3 yrs. old) that has as least one one-year-old whip that is flexible and several feet long.



(see next page)

C. Bend this one-year-old whip to the ground in a fashion that will not cause undue strain on any part of the plant (see drawing above.)

D. Locate the general area where this whip's tip will touch the ground. In the place where the tip of the whip touches the ground, prepare the ground for making a tip layer.

E. Spade up an area approximately 2' x 2' and at least 10 inches deep where the tip will be placed in the ground.

F. Now take several handfuls of peat and work it into the top 6 or 7 inches of the loosened ground. (Heavy clay soils may need more peat than others.) The peat is used to keep the soil loose, and to hold moisture.

G. With a dibble stick, poke a hole in the prepared soil that will allow you to insert the tip of the whip about 4 inches in the ground.

H. Make the light wound one-and-a-half inches long about one inch from the tip of the whip (see drawing). Refer to Job Sheet 1 in Unit 2.

I. Dip the tip into a rooting hormone so that the entire wound is treated.

J. Place the tip in the hole made by the dibble stick and firm pack the soil around it to keep it in the soil.

K. Now bend a 12-inch piece of number 9 wire into a narrow horseshoe shape (see drawing) and force it into the ground over the stem about 12 to 18 inches from where the tip is inserted.

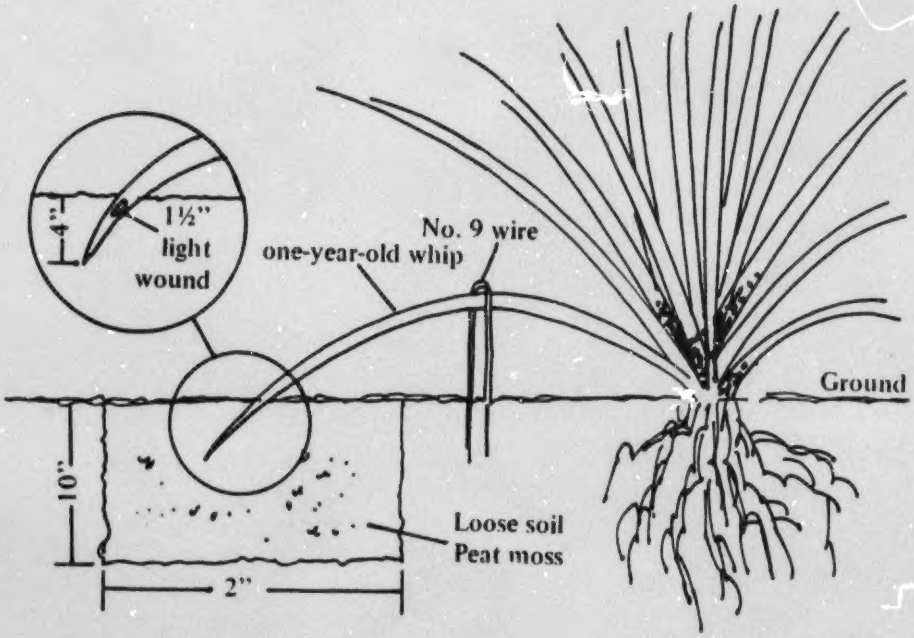
JOB SHEET #1: Propagation by Tip Layerage

NOTE: The wire is only to keep the whip from pulling out of the ground. Do not put too much pressure on the whip with this wire. It should not cause any damage to the whip (see drawing).

L. Now water the tip layer to settle the soil in well around the layer for good soil contact.

M. At the end of the growing season the layers should be well rooted; at this time cut them from the mother plant, just an inch above where they enter the ground.

N. In the spring when the new layered plants start to grow well (several mature leaves) dig them up and transplant them.


4"
1½" light wound
No. 9 wire
one-year-old whip
Ground
10"
Loose soil
Peat moss
2"

PLANT PROPAGATION

UNIT 8

JOB SHEET #2: Propagation by Simple Layerage

I. Equipment and Materials Needed:

A. A healthy, mature, red raspberry bush.

B. A round point spade.

C. A 12 inch piece of No. 9 wire.

D. A two-foot lath stake.

E. Some twine.

F. A sharp knife.

G. Some rooting hormone.

H. Some horticultural peat.

I. A hammer.

J. A brick.

II. Procedure:

A. This job should be done at the start of the growing season.

B. Select a healthy, mature, red raspberry bush (2 or 3 years old) that has at least one one-year-old whip that is flexible and several feet long.

C. Bend this one-year-old whip to the ground and locate a spot about 2 feet from its end where the ground will be prepared.

D. Having located this spot, spade up an area 2' x 2' and at least 10 inches deep where the whip will be placed in the ground.

E. Now take several handfuls of peat and work it into the top 6 or 7 inches of the loosened ground. (Heavy clay soils may need more peat than others.) The peat is used to keep the soil loose and to hold moisture.

F. Having prepared the 2'x2' space and mixed in the peat, now dig out a narrow trench about 12 inches long and 6 inches deep as wide as your hand. This is best done with your hands.

G. Locate the part of the whip which will be laid in this trench. At the point on the whip that is in the middle of the trench, make a layerage wound about 1/3 to 1/2 of the thickness of the stem.

H. Insert a small pebble in the wound to keep it open and sprinkle the wound with rooting hormone. Care needs to be taken when placing the stem in the ground so that the pebble remains in the wound. Otherwise the wound may seal over and rooting will not take place.

I. Bend a 12-inch piece of No.9 wire into a narrow horseshoe shape, JOB SHEET #2: Propagation by Simple Layerage

and force it into the ground across the whip so that the wounded area is held firmly in the bottom of the trench. (See drawing)

NOTE: Be sure the pebble does not fall out of the wound.

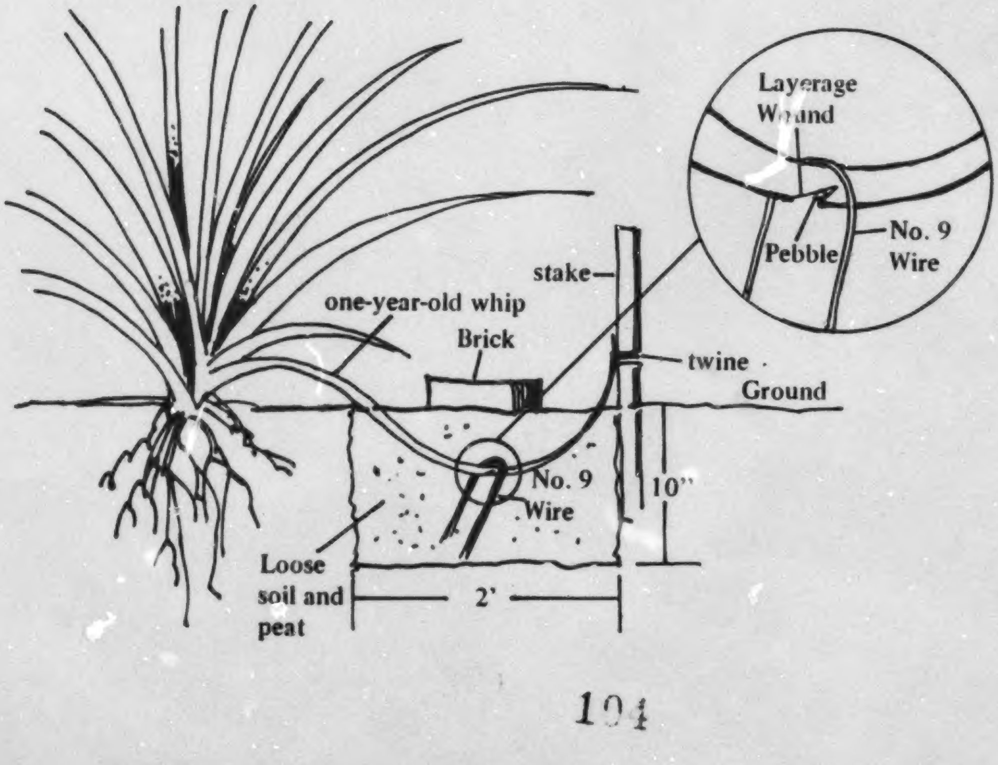
J. Fill in the trench with the soil-peat mixture which you removed with your hands earlier, and tamp it with your foot. Then place a brick on the soil directly above the layered section.

K. Approximately a foot of the end of the whip should now remain above ground (see drawing). Place a lath stake beside the end of this whip and with some twine, tie the tip in an upright position.

L. Now soak the layered portion of the whip with a bucket of water. This will settle the soil around the buried whip section to give good whip-soil contact.

M. At the end of the growing season, the layers should be well rooted; at this time cut them from the mother plant, just an inch above where they enter the ground.

N. In the spring when the new layered plants start to grow well, dig them up and transplant them.



PLANT PROPAGATION

UNIT 8

JOB SHEET #3: Propagation by Air Layerage.

I. Equipment and Materials Needed:

A. A healthy, mature, tomato plant.

B. A sharp knife.

C. Some sphagnum moss.

D. An 8 x 12 inch sheet of clear polyethylene.

E. Some twine.

F. A rooting hormone.

G. A 1/2 inch length of match stick.

II. Procedure:

A. Select a mature, healthy tomato plant.

B. Choose a branch near the middle of the plant that is at least 1/4 inch in diameter and at least a foot long.

C. Choose a place below a node which is about 8 to 10 inches from the tip of the branch, and carefully remove all of the leaves for 4 inches on both sides of this node.

D. Make a layerage wound about an inch below a node.

E. Soak two handfuls of sphagnum moss in water and squeeze it out so it is just damp.

F. Treat the wounded area with a rooting hormone.

G. Insert a one-half length of match stick in the base of the wound to keep it held open (see drawing).

H. Now place the damp moss around the entire wounded area. (You may need another student to help you at this point.) The moss should form a ball over the wounded area.

I. Carefully wrap the 8 x 12 inch plastic sheet around the moss, and tie it tightly at both ends to prevent any moisture from escaping (see drawing). (NOTE: Be careful not to damage the stem).

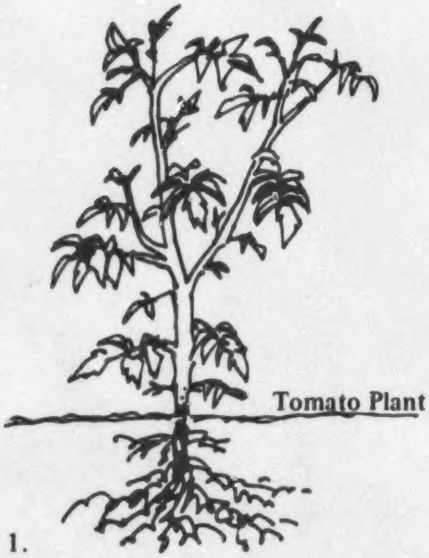
J. Place the tomato plant in the greenhouse for a period of about 10 days, or until you can see roots appearing through the moss to the plastic.

K. When roots appear, remove the plastic sheet, but allow what moss that wants to cling to the roots to do so.

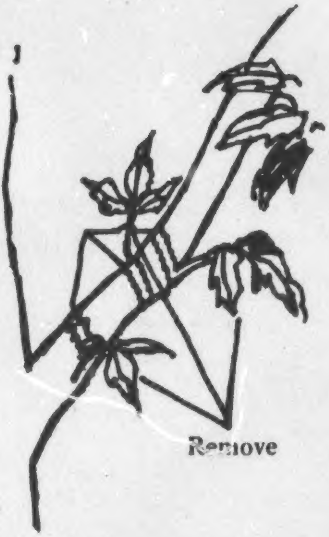
L. Remove the branch from the mother plant with a 45° angle cut just below the lowest roots that have formed.

JOB SHEET #3: Propagation by Air Layerage

M. Transplant the branch and what moss remains on it.


Tomato Plant

1.



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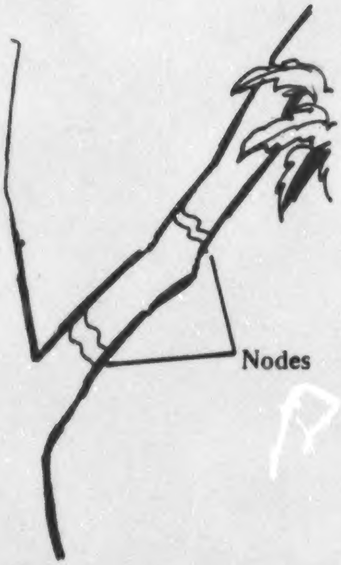

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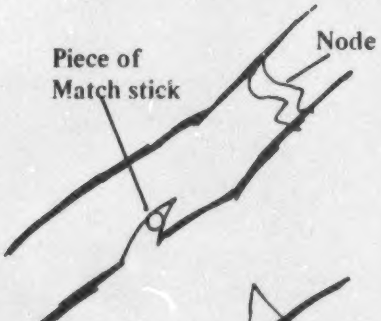
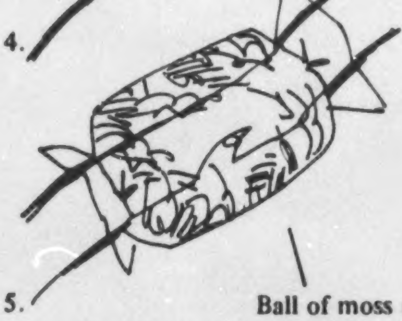

Piece of
Match stick
Node

4.


Ball of moss (Sphagnum)
wrapped in plastic

5.

PLANT PROPAGATION

UNIT 8

TEST

1. Name two advantages of propagation by layerage.
2. Name two disadvantages of propagation by layerage.
3. a. List the five kinds of ground layerage.
   b. Fill in the blanks in this statement: ____________________ layerage is called an __________________________ ground layerage.
4. List two points to consider when transplanting layerage plants.
5. Perform job in Job Sheet 1 to the satisfaction of the instructor.
6. Perform job in Job Sheet 2 to the satisfaction of the instructor.
7. Perform job in Job Sheet 3 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 9

PROPAGATION BY DIVISION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to list the types of plants that can be propagated by division; to name in sequence the procedures of plant division; and to list plants suitable for plant division. They will be able to demonstrate the division of a perennial and a bulbous plant. This objective will be considered achieved upon completion of the jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

Upon completion of this unit, students will be able to:

1. Name five types of plants that can be propagated by division.
2. Name in sequence the procedures of plant division.
3. Name at least five plants that can be propagated by division.
4. Demonstrate propagation by division of perennials. (Job Sheet #1)
5. Demonstrate propagation by division of bulbous plants. (Job Sheet #2)

PLANT PROPAGATION

UNIT 9

INFORMATION SHEET

I. Types of Plants That Can Be Propagated by Division

A. Rhizomes

B. Stem tubers.

C. Tuberous roots.

D. Bulbs

E. Perennials

F. Stolons

II. Steps in the Process of Plant Division

A. Dig up plant, leaving a clump of soil around roots. Usually this step should take place in the dormant season or after blossoming.

B. Shake plant clumps free of soil.

C. Divide plant clumps into units or small plants, each having roots, stems, buds, and leaves (or the potential of having these parts).

D. Dust the plant division with sulphur for prevention of disease.

E. Plant in containers or in the place where they are to grow permanently.

III. Some Plants Which Can Be Propagated by Division

A. Daylilies

B. Iris

C. Chrysanthemum

D. Geranium

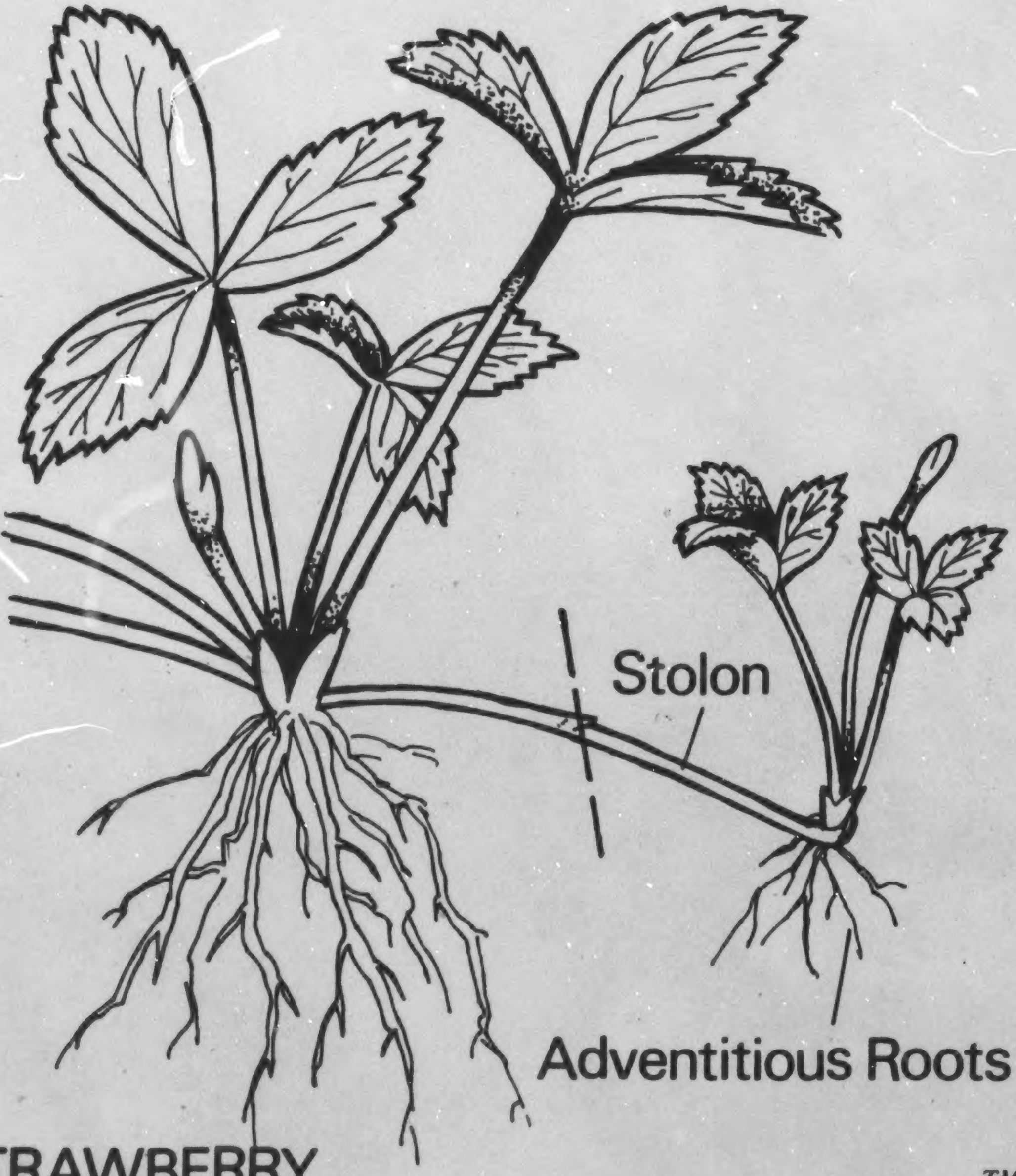
E. Sansevieria

F. Shrubs (primrose, jasmine, fig tree)

G. Daffodils, tulips, etc.

H. Strawberries

Asexual Propagation through Division (Stolon)

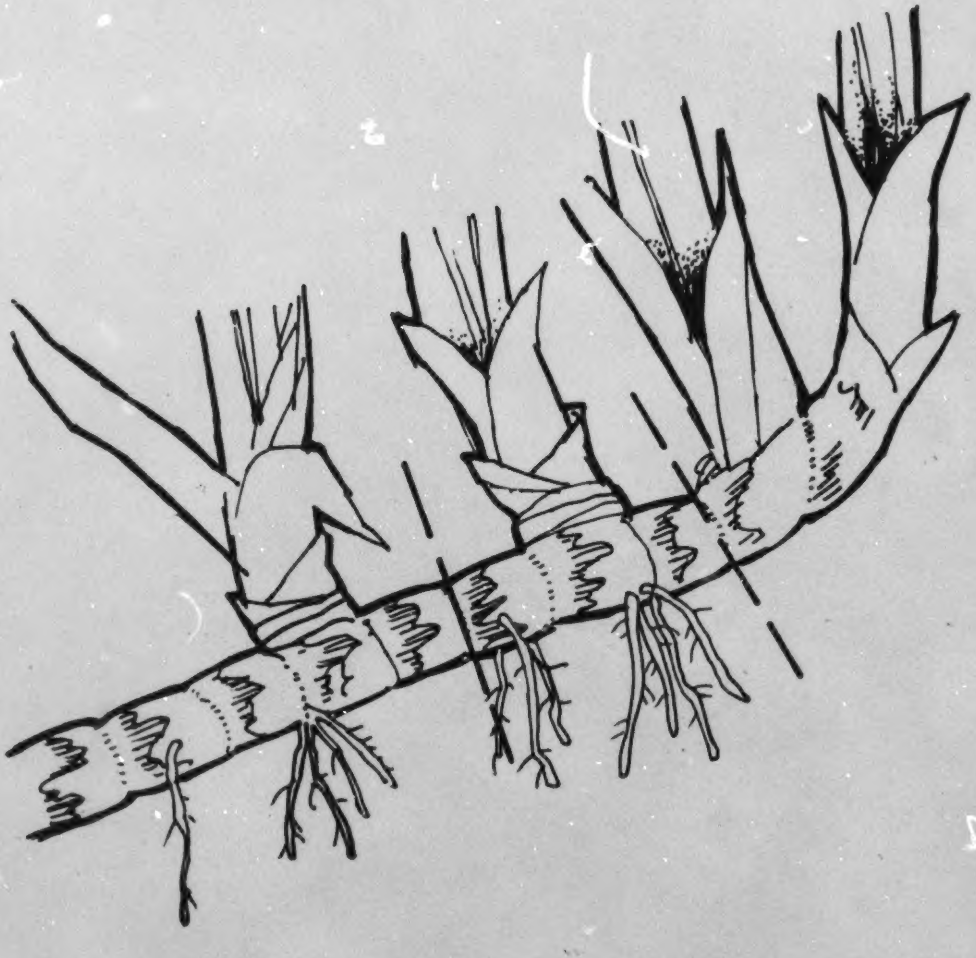

Stolon
Adventitious Roots

STRAWBERRY

TM 1

Asexual Propagation through Division

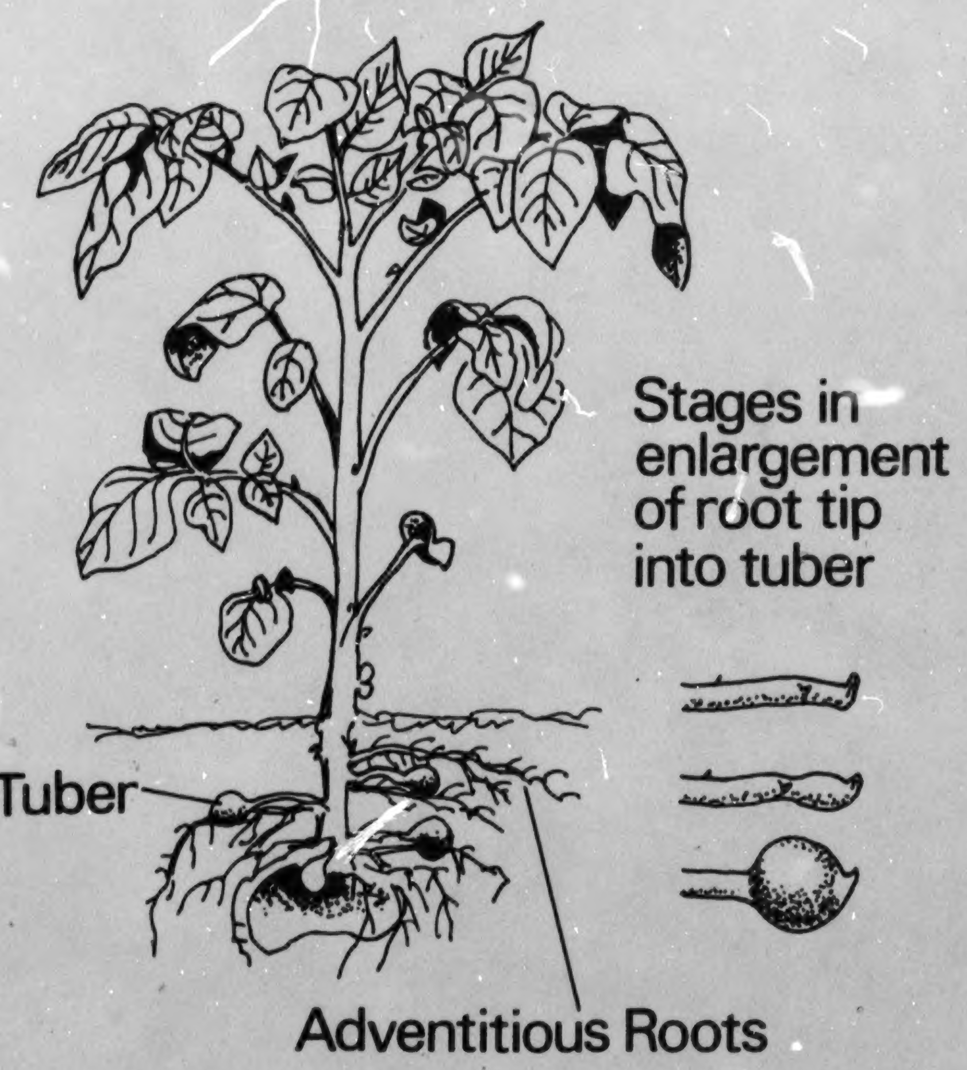
(Rhizomes)



IRIS

TM 2

Asexual Propagation through Division (Tubers)


Stages in enlargement of root tip into tuber
Tuber
Adventitious Roots

POTATO

TM 3

PLANT PROPAGATION

UNIT 9

JOB SHEET #1: Propagation by Division of Perennials.

I. Equipment and Materials Needed:

A. One three- or four-year-old daylily plant.

B. Two short-handled garden forks.

C. A small hand-fork.

D. Sulphur.

II. Procedure:

A. This job should be performed in early fall.

B. Select a healthy growing daylily that is a few years old and has become crowded due to increased new growth.

C. Using a short-handled garden fork, dig around the plant until it can be lifted from the ground.

NOTE: A spade is not recommended because it destroys too many roots. Care should be taken to allow as many roots as possible to remain attached to the plant.

D. Having removed the clump from the ground, set it upright and insert the two short-handled forks into the clump and separate the clump into several sections.

NOTE: After the larger clumps are divided, a small hand fork is often easier to use than the larger fork.

E. Now the roots of the plant should be dusted with sulphur to prevent disease before they are transplanted. You can either sprinkle the sulphur onto the roots or, if many plants are to be treated, it will be best to put some sulphur in the bottom of a bucket and dip the roots in it.

F. The plants should now be transplanted as soon as possible.

PLANT PROPAGATION

UNIT 9

JOB SHEET #2: Propagation by Division of Bulbous Plants.

I. Equipment and Materials Needed:

A. A garden spade

B. Sulphur

C. Daffodil clump

II. Procedure:

A. This job should be performed after the bloom season is well past and the foliage has dried and withered.

B. Using a garden spade, carefully dig around the parent plant until it can be removed from the ground without damaging the plant or the bulblets attached to it.

C. Shake the soil from the roots, and carefully remove the bulblets from the mother plants.

NOTE: Remove only those bulblets which break away easily.

D. Dust the bulblets with sulphur to prevent disease until they are planted.

E. Store the bulbs and bulblets in a cool, dry place until fall and then transplant them.

PLANT PROPAGATION
UNIT 9
TEST

1. Name five types of plants that can be propagated by division.
2. Name in sequence the steps of the plant division process.
3. Name at least five plants that can be propagated by division.
4. Perform job in Job Sheet 1 to the satisfaction of the instructor.
5. Perform job in Job Sheet 2 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 10

PROPAGATION BY BUDDING

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terms pertaining to propagation by budding; to state facts concerning budding; to name basic techniques in propagation by budding; and to state the different methods of propagation by budding. Students will also be able to state the facts, precautions, and examples of both "T" and "patch" budding, and to demonstrate the field operation of "T" budding. This objective will be considered achieved upon successful performance of the job assigned, and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define the terms; cambium layer, scion, budding, and node.
2. State four facts concerning budding.
3. State two basic techniques in propagation by budding.
4. Name two methods of budding.
5. State three facts concerning T-budding.
6. List three precautions to be used with T-budding.
7. Name one common use for T-budding.
8. List two facts concerning patch budding.
9. Name three variations of patch budding.
10. List four precautions to be used when propagating by patch budding.
11. Name one common use for patch budding.
12. Perform the job of a T-bud on an apple tree. (Job Sheet #1)

PLANT PROPAGATION

UNIT 10

INFORMATION SHEET

I. Terms and Definitions:

A. Cambium layer - Located immediately under the bark are cells known as the cambium layer, responsible for the growth of the plant in diameter.

B. Scion (sometimes spelled cion) - a piece cut from a plant or tree; twig or shoot used for grafting.

C. Budding - A special type of grafting using a single bud (scion) inserted into the bark of another variety.

D. Grafting - Method of inserting buds, twigs, or shoots from one kind of plant on stems or roots of other plants.

E. Stock (plants) - Plants from which cuttings (scions) are taken.

F. Node - The joint on the stem of a plant from which leaves, buds, or other structures grow.

II. Some Facts Concerning Propagation by Budding

A. Budding is a form of grafting which utilizes only one bud and a small piece of bark.

B. The two plants involved must be compatible, so that the union between the two will be completed and will hold satisfactorily.

C. Budding is confined generally to young plants, or to the branhes of large plants that are from 1/4 to 1 inch in diameter.

D. Budding is widely used in producing nursery stock of named varieties on selected rootstock. Example: hybrid roses.

III. Basic Necessities for Propagation by Budding

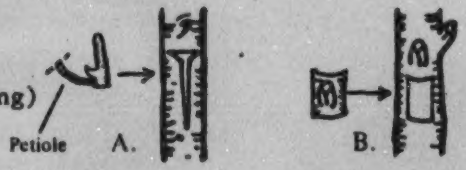
A. The cambium of the bud must be matched with that of the plant being budded.

B. Budding is done primarily during the spring and summer months while the plant is in active growth (bark is easily separated from the plant at this time).

IV. Methods of Budding

A. T-Budding (also called shield budding)

B. Patch Budding



V. Basic Steps in T-Budding (the most common method of budding plants)

A. Shield-shape bud patch is taken from the budwood (See Job Sheet #1).

B. Shield is slipped into the "T" cut on the stock.

C. Shield is wrapped to keep out excessive moisture and to hold bud in place.

INFORMATION SHEET

VI. Precautions to be Used with T-Budding

- A. If considerable rainfall is likely to occur during the budding season, the "T" bud should be inverted.
- B. Wound must be allowed to drain. Accumulated moisture can delay healing.
- C. Inverted "T" bud should be used on plants which are likely to bleed.
- D. Care must be taken when reversing the cutting of the bud shield-bud must be pointed in the right direction to secure normal, rapid growth.

VII. Common Use of T-Budding Propagation

- A. T-budding is commonly used for propagating fruit trees (e.g., apple, peach, nectarine, and apricot trees).

VIII. Basic Steps in Patch Budding

- A. Rectangular patch of bark is removed from the plant to be budded.
- B. This patch is replaced with another of a similar size and shape, containing a bud of the variety to be propagated.

IX. Variations of Patch Budding

- A. I-Budding - The bark on the stock is split in the shape of an "I" and the patch is inserted beneath the two flaps.
- B. Flute budding - All but about 1/8 of a ring of bark is removed and a similar patch is placed on the stock.
- C. Ring Budding - A full ring of bark is removed from the stock and a bud patch of the same size and shape replace it.

X. Precautions To Be Used with Patch Budding

- A. The size of the budstick should be about the same as the stock to insure a tighter fit.
- B. The bark on both the stock and the budwood must slip easily.
- C. The patch should be removed from the budstick by pushing it sideways so as to retain the core of the bud.
- D. The bud patch should be the same size and shape as the patch removed from the stock.
- E. Care should be taken to have the patch in close contact with the stock and fitted closely to the edges of the cuts on the stock.
- F. When tying the patch, leave the bud exposed and keep the patch from buckling. On a fast-growing stock, cut the tie after ten days, but do not remove the tie materials.

INFORMATION SHEET

Common Use of Patch Budding - Patch budding is commonly used on thick-barked trees; e.g., pecan and walnut.

G. Shape the bud shield as indicated in the drawing so it is about ½ inch wide and 3/4 of an inch long.

H. Carefully lift the edges of the T cut and slip the bud shield under them as indicated in the drawing. Be sure that the shield fits flush against the top of the T. This will insure good cambium layer contact between the bud shield and the mother plant.

I. Carefully tape the bud shield in place as indicated in the drawing.

(NOTE: Tape should not cover the bud shield).

J. In about two weeks you will need to check and see if the bud has taken. It will turn black if it did not take. Try again, even experts fail at budding occasionally.

PLANT PROPAGATION

UNIT 10

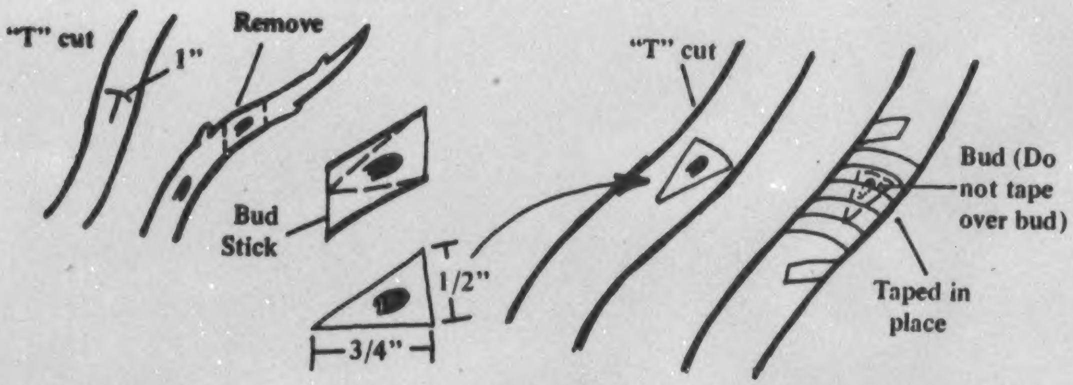
JOB SHEET #1: Propagation by Budding

I. Equipment and Materials Needed:

- A. A mature, healthy apple tree.
- B. A budstick of a different variety.
- C. A very sharp knife.
- D. Grafting tape.

II. Procedure:

- A. This job should be done during the early part of the growing season.
- B. Choose a warm day so that the cambium layers of the tree will not be frozen.
- C. Select a limb on the tree that is 2 to 3 inches in diameter.
- D. Choose an area on the limb that is smooth and free of buds. This limb should be chosen so the new variety will have room to develop.
- E. Make a one-inch T cut on the limb as indicated in the drawing. A very sharp knife should be used. The cut should be made through the cambium layer.
- F. Remove a one-inch long piece of bark containing a bud from the budstick. Be sure to remove the bark in a manner which will get all of the cambium and not injure the bud. (NOTE: Place bud opposite prevailing wind.)



PLANT PROPAGATION

UNIT 10

TEST

1. Define:
    a. Cambium layer
    b. Cion
    c. Budding
    d. Node
2. State four facts concerning budding.
3. State two basic necessities for propagation by budding.
4. Name two methods of budding.
5. State the basic three steps in T-budding in the correct order.
6. State three precautions to be used with T-budding.
7. Name a common use of T-bud propagation.
8. State the basic steps in patch budding in correct order.
9. Name three variations of patch budding.
10. State four precautions to be used when propagating by patch budding.
11. Name a common use of patch-bud propagation.
12. Perform job in Job Sheet #1 to the satisfaction of the instructor.

PLANT PROPAGATION

UNIT 11

GRAFTING

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terminology pertaining to grafting; to state reasons for, the limitation of, and the formation of graft unions; to name the functions of callus tissue; to list the classifications of grafting; to name the different means of grafting; and to state the qualities, functions, and kinds of grafting waxes. They will also be able to demonstrate side grafting in the field, along with proper use of grafting waxes. This objective will be considered achieved upon successful completion of the jobs assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that relate to grafting.
2. State three reasons for use of graftage.
3. Name two limitations of the use of graftage.
4. List in sequence the formation of a graft union.
5. Name three functions of the callus tissue.
6. List two ways that the many different kinds of grafting are classified.
7. Name the two kinds of grafting that are used when the diameter of the stock and cion are similar.
8. Name the four kinds of grafting that are used when the diameter of the stock is greater that the cion.
9. Name two qualities that grafting waxes must possess.
10. List three basic functions of grafting waxes.
11. State three basic kinds of grafting waxes.
12. Demonstrate side grafting in the field.

PLANT PROPAGATION

UNIT 11

INFORMATION SHEET

I. Terms and Definitions:

A. Cambium layer - Name for cells responsible for growth of a plant in diameter, located immediately under the bark.

B. Cion (sometimes spelled scion) - A piece cut from a plant or tree; twig or shoot used for grafting.

C. Understock - Lower part of the graft; the rooted end.

D. Stock plant - Plants from which cuttings are taken.

E. Graftage - Union of two separate stems, one having two or more buds.

F. Dicot - Plant that produces two seed leaves.

G. Monocot - Plant that produces one seed leaf.

H. Conifer - Any of an order of evergreen shrubs and trees characterized by needleshaped leaves, stroboli, or cones, and a resinous wood.

I. Respiration - The controlled breaking down or burning of glucose manufactured through photosynthesis to produce energy for plant process.

J. Meristematic - With plant tissue, being in the process of formation with cells actively dividing and growing.

K. Parenchyma - The thin-walled, soft cell tissue of higher plants as found in stem pith and in the pulp of fruit.

L. Phloem - A complex tissue made of cells that transport manufactured compounds.

M. Xylem - A complex tissue (wood) made of cells that transport water and essential raw materials in water.

II. Reasons for the Use of Graftage

A. Changing of the tops of trees, usually from an undesirable variety to a desirable variety.

B. Growing of several kinds of flowers or fruit on one tree or plant.

C. Utilization of stocks which influence the growth of the cion, which thrive well in poorly drained or heavy soils, or which are resistant to certain pests.

Examples:

1. Certain apple stock impart a dwarfing effect on the growth of a cion but not on the size of the fruit.
2. Certain species of citrus tolerate unfavorable soil conditions.
3. Certain species of peach are resistant to nematodes.

INFORMATION SHEET

III. Limitations in the Use of Graftage

A. Limited to plants which develop a secondary plant body; e.g., conifers and dicots (monocots cannot be grafted very readily).

B. Limited to structures which are closely related botanically; e.g., apple and crabapple; pecan and hickory; and garden rose and wild rose.

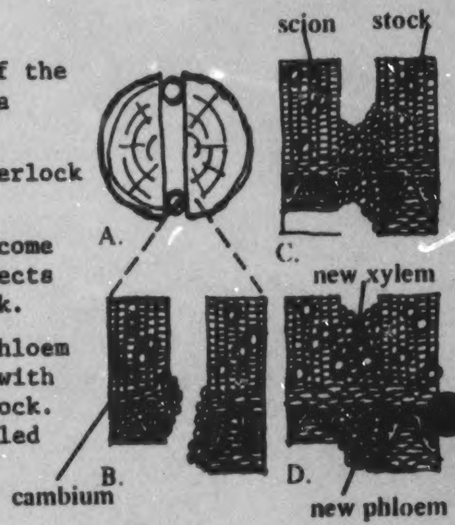
IV. Formation of the Graft Union

A. The exposed cells of the cambium of each of the two structures produce a mass of parenchyma cells.

B. These parenchyma cells intermingle and interlock with each other.

C. Certain cells of this parenchyma tissue become meristematic and form a cambium which connects with that of the cion and that of the stock.

D. This cambium divides and forms secondary phloem and secondary xylem which in turn connect with the secondary xylem of the cion and the stock. These tissues which form the union are called callus.



V. Function of the Callus Tissue in Grafting

A. The callus forms a living bridge between the cion and the stock.

B. Water and essential raw materials pass from the stock to the cion.

C. Manufactured foods and hormones pass from the cion to the stock.

VI. Classification of Kind of Grafting

A. Certain kinds of grafting are used when the diameter of the stock and the cion are similar.

1. Tongue, root or whip grafting
2. Approach grafting

B. Certain kinds of grafting are used when the diameter of the stock is greater than that of the cion.

1. Cleft grafting
2. Bark grafting
3. Notch grafting
4. Wedge grafting

VII. When Diameters of Stock and Cion Are Similar (Age of the stock and cion should be practically same).

A. Tongue, root, or whip grafting (also called side grafting).

INFORMATION SHEET

1. See Job Sheet #1 of this unit for description.
2. Examples: Used on apple trees, pear trees, etc.

B. Approach grafting (See TM 1)

1. Consists of joining the stems of plants growing on their own roots.
2. Examples: used on conifers and evergreens.

VIII. When Diameters of Stock Is Greater Than That of Cion

A. Cleft grafting consists in: (See TM 2)

1. Splitting the stock branch down the center.
2. Holding the wedge open while the cions are inserted.
3. Placing the cion in the cleft in such a way as to insure contact of the cambia.
4. Waxing over the cut surface.
5. Advantage - can be done in the dormant season.
6. Disadvantage - wood decaying organisms may get into the graft.

B. Bark grafting consists in:

1. Splitting the bark of the stock.
2. Nailing the cion in place.
3. Waxing over the cut surface.
4. Advantage - can be done in the spring.
5. Disadvantage - cion wood must be gathered when dormant and stored.

C. Notch grafting consists in:

1. Notching the bark of the stock.
2. Cutting the cion to fit the notch.
3. Nailing the cion in place.
4. Waxing over the cut surface.
5. Advantages - of both the cleft and bark grafting.
6. Disadvantage - requires a lot of time to do properly.

D. Wedge grafting consists in:

1. Removing a V-shaped wedge of tissue down the middle of the stock.
2. Making a tapering wedge at the base of the cion.
3. Inserting the cion in the wedge of the stock so that the cambia of the stock and cion are in contact with or close to each other.

INFORMATION SHEET

IX. Necessary Qualities of Grafting Waxes

- A. Must not crack or melt at ordinary temperatures.
- B. Must be free from substances toxic to the tissues.

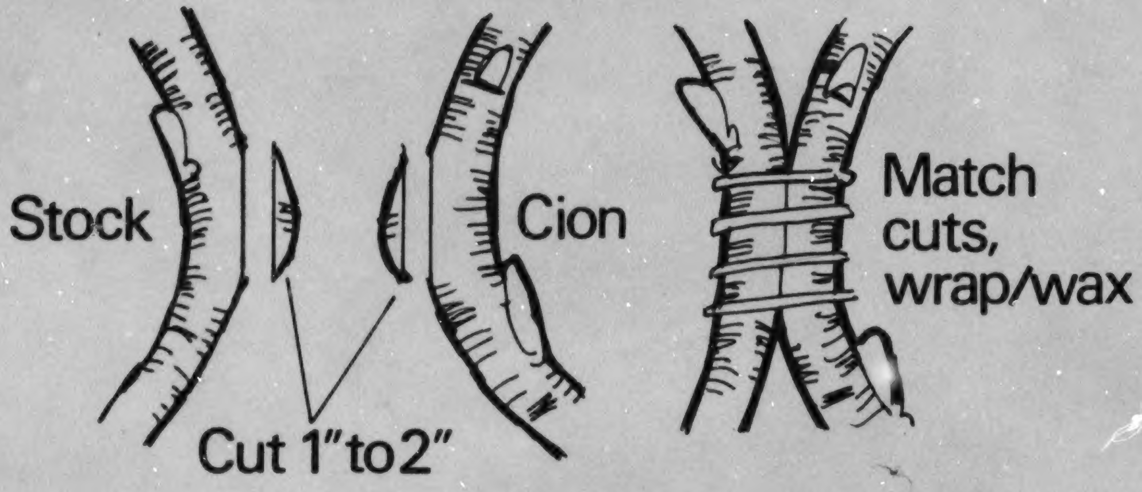
X. Basic Functions of Grafting Waxes.

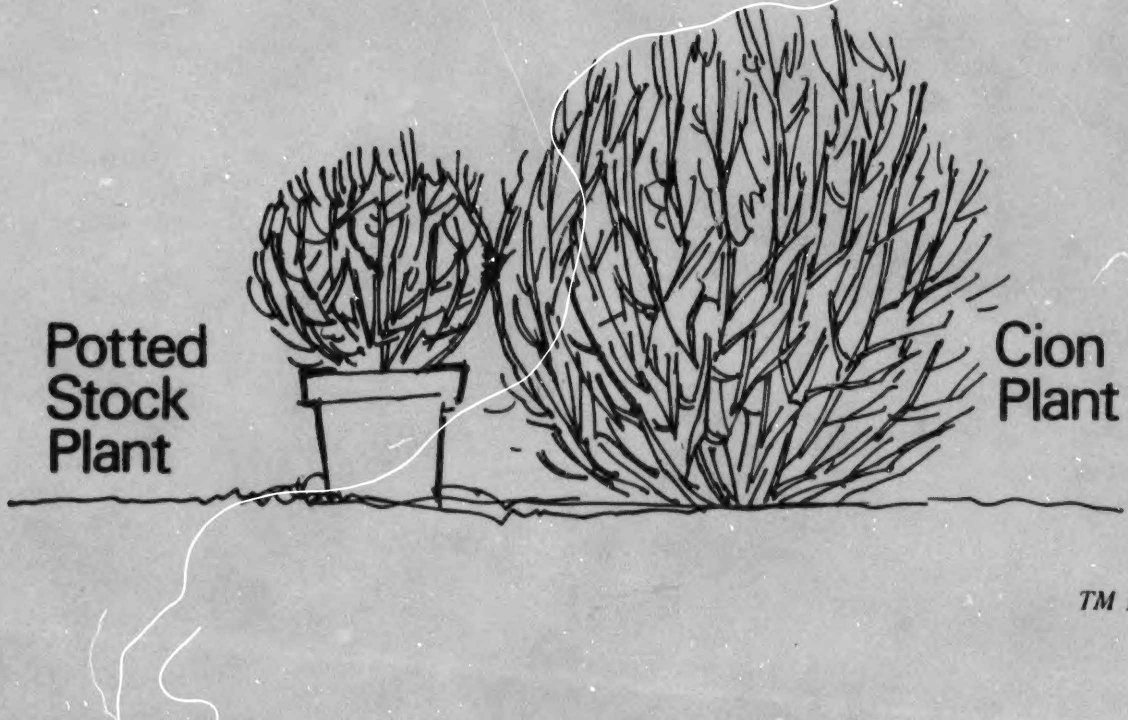
- A. To protect the wounded surface from wood-decaying fungi.
- B. To retard transpiration from the tissues.
- C. To permit the normal exchanges of oxygen and carbon dioxide in respiration.

XI. Basic Kinds of Grafting Waxes

- A. Hard
- B. Soft
- C. Emulsified-asphalt

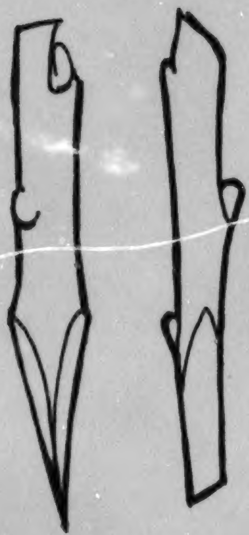
Approach Grafting


Stock
Cion
Match cuts, wrap/wax
Cut 1" to 2"

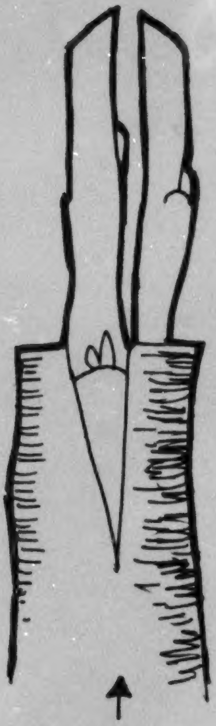

Potted Stock Plant
Cion Plant

TM 1

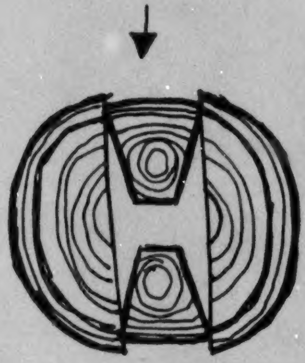
Cleft Grafting

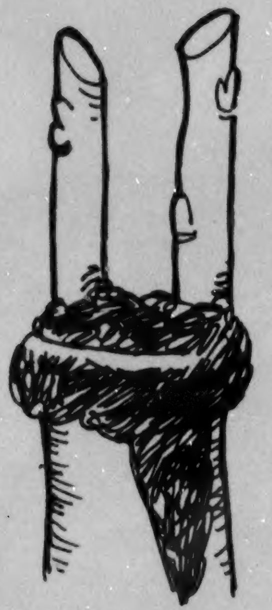


Cions prepared



Cions inserted in stock





Cut surface waxed

TM 2

PLANT PROPAGATION

UNIT 11

ASSIGNMENT SHEET #1: Grafting Waxes, Tools, and Tapes

I. Visit a local nursery farm and/or a local nursery supply store.

  A. Make a list of the different kinds of waxes, tools and tapes used in grafting.

  B. State the best usage of each item.

PLANT PROPAGATION

UNIT 11

TEST

1. Match:

______a. Conifer
______b. Meristematic
______c. Phloem
______d. Cambium layer
______e. Understock
______f. Graftage
______g. Monocot
______h. Respiration
______i. Parenchyma
______j. Xylem
______k. Cion
______l. Stock plant
______m. Dicot

1. Located immediately under the bark cell; responsible for growth of a plant in diameter.
2. A piece cut from a plant or tree; twig or shoot used for grafting.
3. Lower part of the graft; rooted end.
4. Plants from which cuttings are taken.
5. Union of two separate stems, one having two or more buds.
6. Plant that produces two seed leaves.
7. Plant that produces one seed leaf.
8. Any of an order of evergreen shrubs and trees characterized by needle-shaped leaves, stroboli, or cones, and resinous wood.
9. The controlled breaking down or burning of glucose manufactured through photosynthesis to produce energy for plant processes.
10. With plant tissue, in process of formation, with cells actively dividing and growing.
11. The thin-walled, soft cell tissue of higher plants as found in stem pith and in the pulp of fruit.
12. A complex tissue made of cells that transport manufactured compounds.
13. A complex tissue made of cells that transport water and essential raw materials in water.

2. State three reasons for the use of graftage.

3. Name two limitations on the use of graftage.

4. List in sequence the formation of a graft union.

5. Name three functions of the callus tissue.

6. List the two criteria by which different kinds of grafting are classified.

TEST

7. Name two kinds of grafting that are used when the diameter of the stock and the cion are similar.

8. Name four kinds of grafting used when the diameter of the stock is greater than the cion.

9. Name two qualities that grafting waxes must possess.

10. List three basic functions of grafting waxes.

11. State three basic kinds of grafting waxes.

12. Perform job in Job Sheet #1 to the satisfaction of the instructor.

SOIL AND PLANT GROWTH MEDIA

UNIT 1

NATURE AND PROPERTIES OF SOILS

TERMINAL OBJECTIVES

Upon completion of this unit, students will be able to list concepts pertaining to the nature and properties of soils. They will be able to identify factors responsible for the formation of soils; list the utilizations of the soil water, and describe the hydrologic cycle. Students will also be able to determine soil texture by feel and identify the various sizes of soil particles. This objective will be considered ach achieved upon completion of the jobs assigned, and the attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to the nature and properties of soil with their definitions.
2. List five factors responsible for the formation of soils.
3. Name three types of rock from which parent material originates.
4. State at least two facts concerning the effects of climate in the formation of soils.
5. State at least two facts concerning the effects of plants and animals in the formation of soils.
6. State two facts concerning the effects of topography in the formation of soils.
7. State three facts concerning the effects of time (age) in the formation of soils.
8. List three horizons found in a soil profile.
9. Identify which of given statements describes characteristics of the "A", "B", or "C" horizons in a soil profile.
10. Name four components of the soil.
11. Identify which of given statements describe characteristics of mineral matter, organic matter, air, or soil water as components of the soil.
12. Name three classifications of water by how it is utilized in the soil.
13. Name at least five of the classifications of soil by texture.
14. Define the hydrologic cycle.

SPECIFIC OBJECTIVES

15. Identify five of the seven kinds of soil structures.
16. Determine and name soil texture by feel. (Job Sheet #1)
17. Identify various sizes of real soil particles. (Job Sheet #2)

SOIL AND PLANT GROWTH MEDIA

UNIT 1

INFORMATION SHEET

I. Terms and Definitions

   A. Nature - The character, constitutions, or essential traits - original. The sum of physical or material existences and forces .

   B. Properties - A characteristic attribute of a substance under stated conditions, especially in relation to the senses, as color, ordor, hardness, density, etc.

   C. Soil - A natural material occurring in a series of layers, composed of weathered rock and minerals plus decayed organic matter, water, and air which supports plants and furnishes them with nutrients and moisture.

   D. Parent material - The raw material from which all soils are developed.

   E. Topography - Contour or "lay" of the land.

   F. Solum - Combination of topsoil and subsoil.

   G. True soil - Solum

   H. Aeration - Air in the soil

   I. Organic - Non-living materials in the soil that came from either plants or animals.

   J. Inorganic - Mineral material in the soil not the result of living or organic processes.

   K. Tilth - The desirable, workable condition of the soil.

   L. Permeability - The movement of air and water through the soil.

   M. Soil structure - The way the individual soil particles are grouped together to form clusters of particles.

   N. Aggregate - A single mass or cluster of soil particles such as clod, crumb, or granule .

   O. Texture - The size of individual particles that make up a soil.

II. Five Factors Responsible for the Formation of Soils

   A. Parent material

   B. Climate

   C. Plants and animals

   D. Topography

   E. Time

INFORMATION SHEET

III. Origin of Parent Material

A. Ingneous rocks - formed from molten (or melted) materials from volcanoes.

B. Sedimentary rocks - formed from an accumulation of materials that have been carried by glaciers, wind, and water flow.

C. Metamorphic rocks - Formed through a process of changes caused by pressure and heat.

(NOTE: As these rock formations are broken down, soils are formed.)

IV. Effects of Climate on Soil Formatior

A. Extreme temperature changes cause expansion and contraction which break down the parent materials.

B. Heavy rainfall and sunlight further cause parent and other material to break down.

C. Climate affects the release of plant nutrients and other processes, which in turn, affect development of soils.

D. As soil matures, more of its characteristics are acquired through the influence of climate.

V. Effects of Plants and Animals of Soil Formation

A. Forms of plant life grow and decay and mix with parent materials.

B. Ants, earthworms, gophers, and roots from plants, aerate the soil.

C. If the climate is temperate, the growth and decay of larger animals and plants tend to enrich soil.

D. Different types of soil will be found in grasslands as opposed to forest lands, partly because different plants and animals exist in each.

VI. Effects of Topography on Soil Formation

A. Steep and mountainous land - Water moves off fast, allowing no buildup of soil.

B. Flat land - Water soaks in, providing adequate moisture to allow a more rapid buildup of soil.

VII. Effects of Time (Age) on Soil Formation

A. Allows parent materials to break down

B. Allows for erosion to have an effect

C. Allows plant life to grow and decay

(NOTE: It is estimated that it takes 100-200 years for soil to mature under ideal conditions - 2000 years under other conditions.)

INFORMATION SHEET

VIII. Three Horizons Found in a Soil Profile. (See TM 1)

- A. "A" horizon (topsoil)
- B. "B" horizon (subsoil)
- C. "C" horizon (basic parent material)

IX. Characteristics of Soil Profile Horizons

- A. The "A" horizon (topsoil)
  - 1. Few inches to more than a foot deep.
  - 2. Highest in organic matter content.
  - 3. Usually darkest in color, because of organic material content.
  - 4. Where most of the bacteria, fungi, and insects and other soil organisms are found.
  - 5. Roots usually branch out better in this area, because of improved physical condition of soil.
- B. The "B" horizon (subsoil).
  - 1. Combination of topsoil and subsoil called "solum" or "true soil".
  - 2. Plant roots grow into the solum.
  - 3. Solum may have been carried in by water, glacier, or wind.
- C. The "C" horizon (parent material)
  - 1. Parent material may or may not have changed.
  - 2. Solum found here may or may not have come from parent material.

X. Components of the Soil (See TM 2)

- A. Mineral matter
- B. Organic matter
- C. Air
- D. Soil water

XI. Characteristics of Ideal Soil Components

- A. Mineral matter
  - 1. Makes up about 45% of the soil.
  - 2. Basically from parent material.
- B. Organic matter
  - 1. Makes up about 1-5% of the soil.
  - 2. Improves the workable condition of the soil (Tilth).
  - 3. Increases aeration (air in soil) in "tight" soils, like clay.
  - 4. Increases the water-holding capacity of sandy or "light" soils.
  - 5. Supports the many microorganisms in the soil that assist in further break-down of organic matter.

INFORMATION SHEET

6. Involved in making some nutrients available to growing plants.
7. Creates aggregates.

C. Air.

1. Makes up approximately 25% of the soil.
2. Located in the pore spaces between the particles of the soil.

D. Soil Water

1. Makes up approximately 25% of the soil.
2. Adheres to soil particles.

XII. Classification of Soil Water by How It Is Utilized

A. Hygroscopic soil water - Water that soil particles take in and become attached to, and that is unavailable for plant use.

B. Capillary soil water - Water that plants can absorb and use for growth.

C. Gravitational soil water - Water that does not adhere to soil particles; it drains down through the soil.

XIII. Classification of Soil by Texture

A. Sand or loamy sand

1. Dry - Clods break easily.
2. Moist - Gritty; forms easily crumbled ball; does not ribbon.
3. Wet - Lacks stickiness, but may show faint clay stainings on fingers.
4. Individual grains can be bath seen and felt under all moisture conditions.
5. Sand is the framework of soils.

B. Sandy Loam

1. Dry - Clods break easily.
2. Moist - Moderately gritty to gritty; forms ball that stands careful handling; ribbons very poorly (See Job Sheet #1).
3. Wet - Definitely stains fingers; may have faint smoothness or stickiness, but grittiness dominates.
4. Individual grains can be seen and felt under nearly all conditions.

C. Loam.

(NOTE: This is the most difficult texture to place since characteristics of sand, silt, and clay are all present but none predominates.)

1. Dry - Clods slightly difficult to break; somewhat gritty.

INFORMATION SHEET

2. Moist - Forms firm ball; ribbons poorly; may show poor fingerprints. Somewhat gritty.
3. Wet - Gritty, smooth, and sticky all at the same time. Stains fingers.

D. Silt or silt loam

1. Dry - Clods moderately difficult to break, which ruptures suddenly into floury powder that clings to fingers; shows fingerprints.
2. Moist - Has smooth, slick, velvety, or buttery feel, forms firm ball; may ribbon slightly before breaking; shows good fingerprint.
3. Wet - Smooth with some stickiness from clay; stains fingers. Grittiness of sand is well masked by other textures present. (Since there are very few pure silt soils, most soils meeting the above description would be silt loam.)

E. Sandy Clay Loam

1. Dry - Clods break with some difficulty.
2. Moist - Forms firm ball that dries moderately hard; forms ½" ribbons that hardly sustain their own weight; may show poor to good fingerprints.
3. Wet - Grittiness of sand and stickiness of clay about equal, masking smoothness of silt; stains fingers.

F. Clay Loam.

1. Dry - Clods break with difficulty.
2. Moist - Forms firm ball that dries moderately hard; ribbons fairly well, but ribbons barely support own weight; shows fair to good fingerprint.
3. Wet - Moderately sticky with stickiness dominating over grittiness and smoothness; stains fingers.

G. Silty Clay Loam (resembles silt loam but with more stickiness of clay).

1. Dry - Clods break with difficulty.
2. Moist - Shows a good fingerprint; forms a firm ball drying moderately hard; ribbons ½" that can be fairly thin.
3. Wet - Stains fingers, has sticky-smooth feel with little grittiness of sand.

H. Sandy Clay

1. Dry - Often cloddy; clods break only with extremepressure.
2. Moist - Forms very firm ball, drying quite hard; shows fingerprints; squeezes out to a thin, long, somewhat gritty plastic, but has some grittiness present.

INFORMATION SHEET

I. Silty Clay

1. Dry - See sandy clay
2. Moist - Forms very firm ball becoming quite hard on drying; shows fingerprints; squeezes out to a thin, long smooth ribbon.
3. Wet - Stains fingers, clouds water; stickiness dominates over smoothness; grittiness is virtually absent.

J. Clay

1. Dry - Cloddy; clods often cannot be broken even with extreme pressure.
2. Moist - Forms firm, easily molded ball drying very hard; squeeze out to a very thin ribbon 2 to 3 inches long.
3. Wet - Stains fingers, clouds water; usually very sticky with stickiness masking both smoothness and grittiness; wets slowly.

XIV. The Hydrologic Cycle (See TM 2)

A. Definition: Movement of moisture over, through, and beneath the soil surface.

B. Origin: This moisture may fall as rain, sleet, or snow.

XV. Kinds of Soil Structure (See TM 4)

A. Crumb

B. Granular

C. Platy

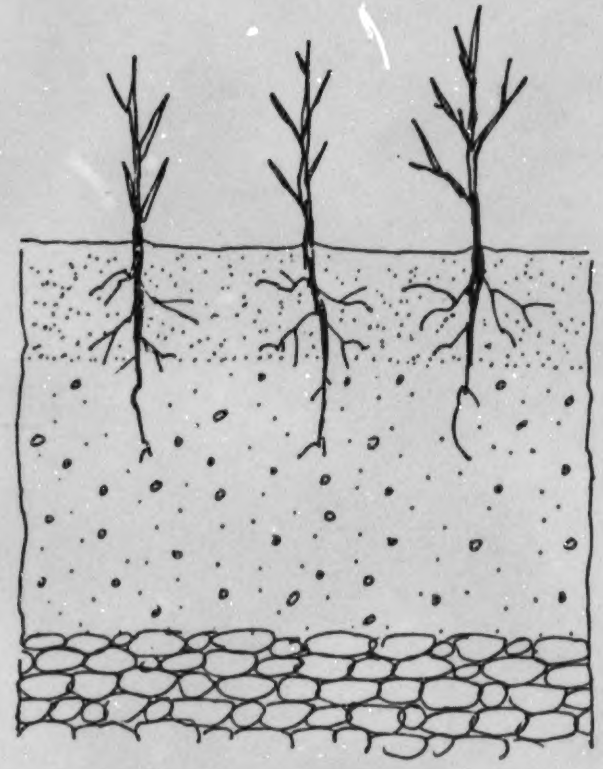
D. Angular blocky

E. Subangular blocky

F. Prismatic

G. Columnar

A Soil Profile, showing Three Layers, or Horizons

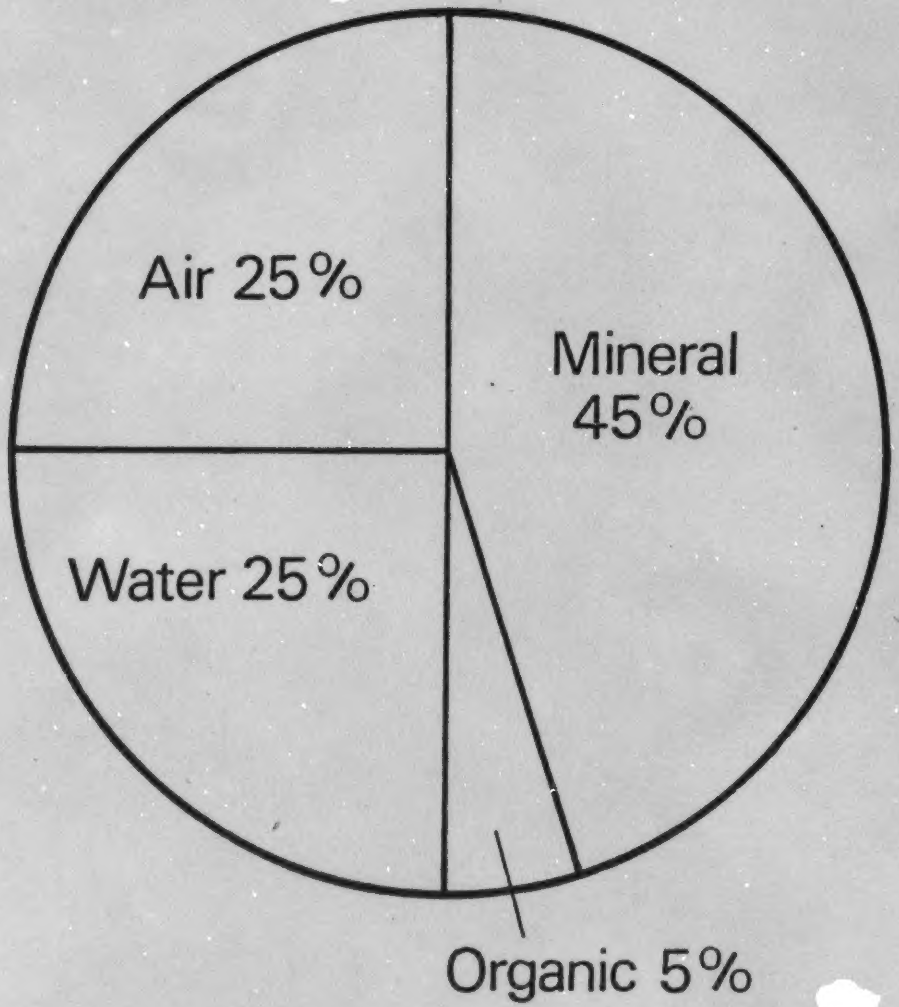


"A" Horizon - Topsoil

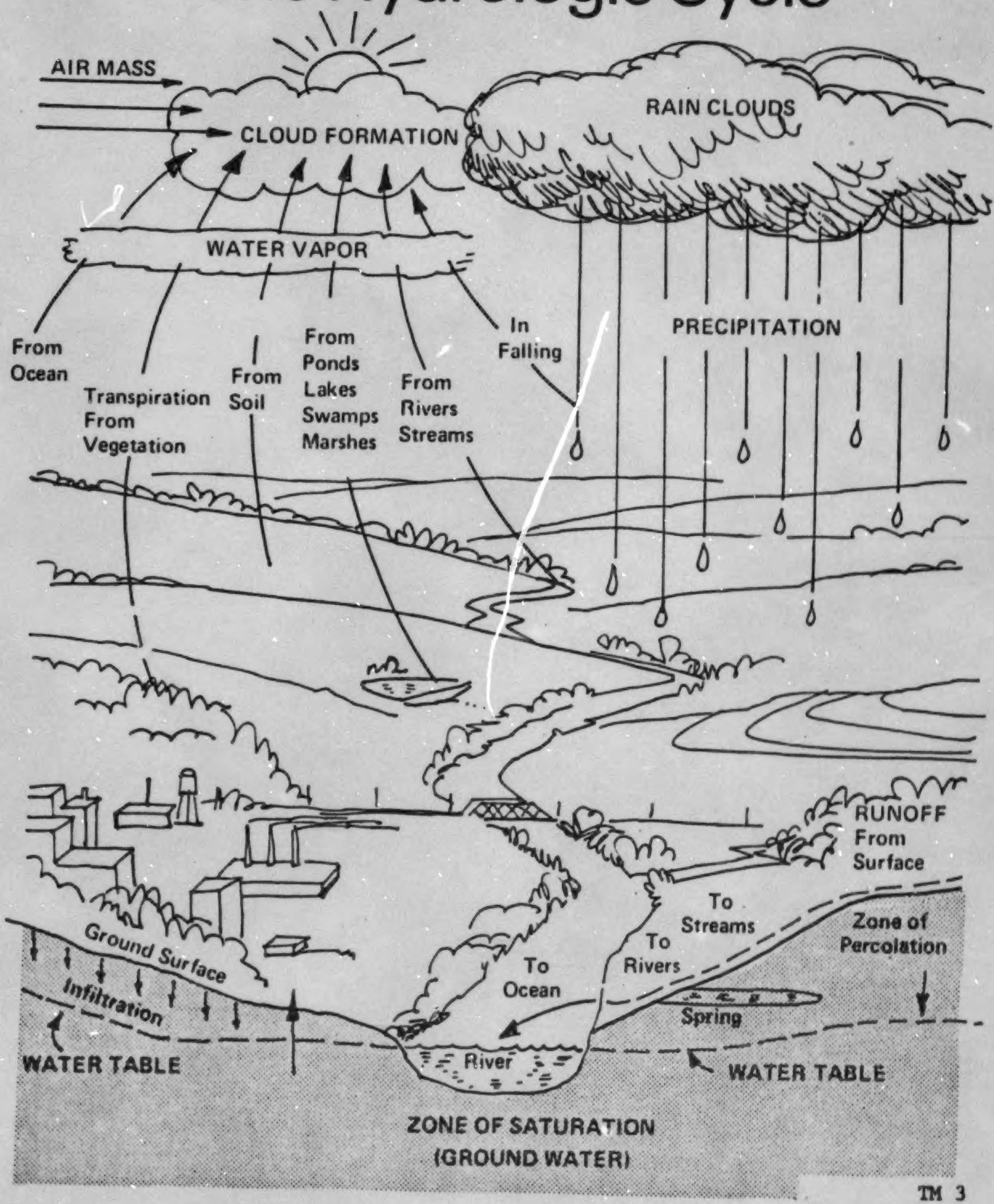
"B" Horizon - Subsoil

"C" Horizon - Parent Material

Components of the Soil and their Approximate Percentages

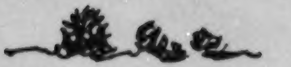


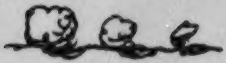
The Hydrologic Cycle

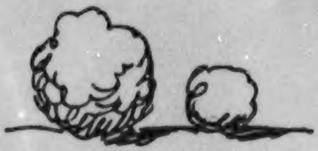

AIR MASS
CLOUD FORMATION
RAIN CLOUDS
WATER VAPOR
PRECIPITATION
From Ocean
Transpiration From Vegetation
From Soil
From Ponds Lakes Swamps Marshes
From Rivers Streams
In Falling
RUNOFF From Surface
To Streams
To Rivers
To Ocean
Zone of Percolation
Ground Surface
Infiltration
Spring
River
WATER TABLE
WATER TABLE
ZONE OF SATURATION (GROUND WATER)

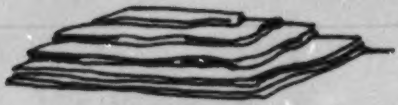
TM 3

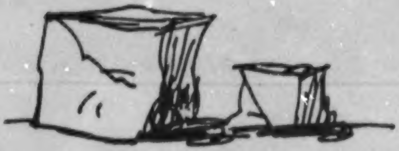
Soil Structure

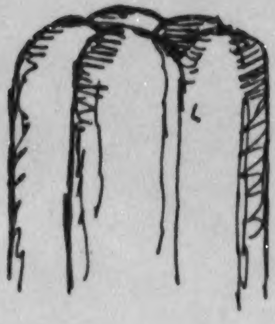

Crumb

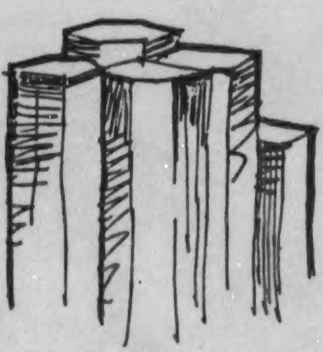

Granular


Subangular Blocky


Platy

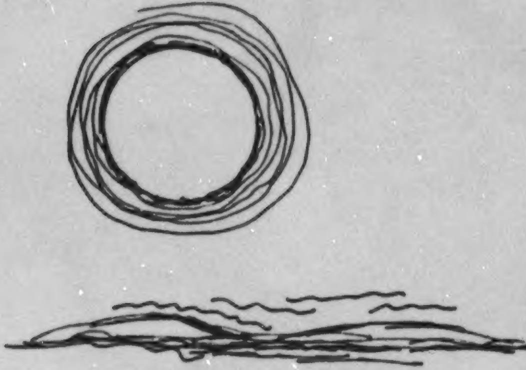

Angular Blocky


Columnar

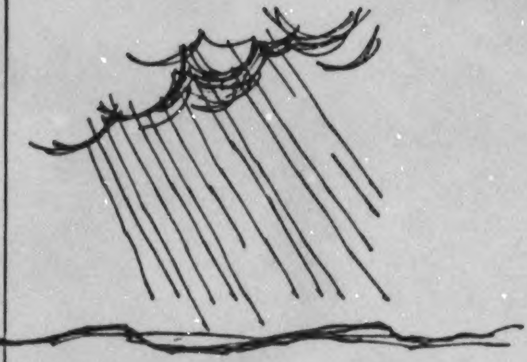

Prismatic

TM 4

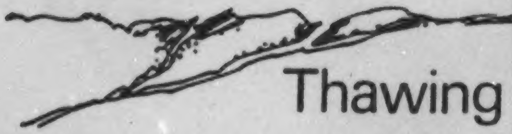
Types of Physical Weathering



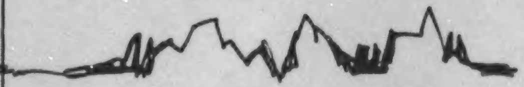
Heating & Cooling



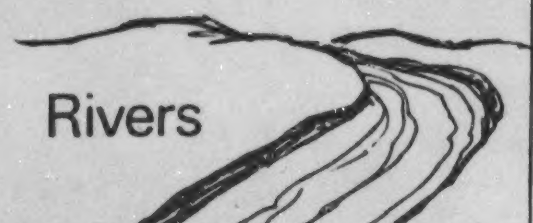
Wetting & Drying



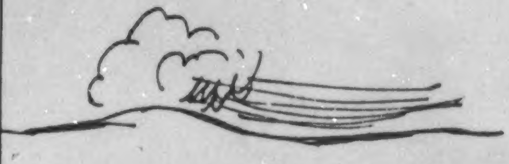
Thawing



Freezing

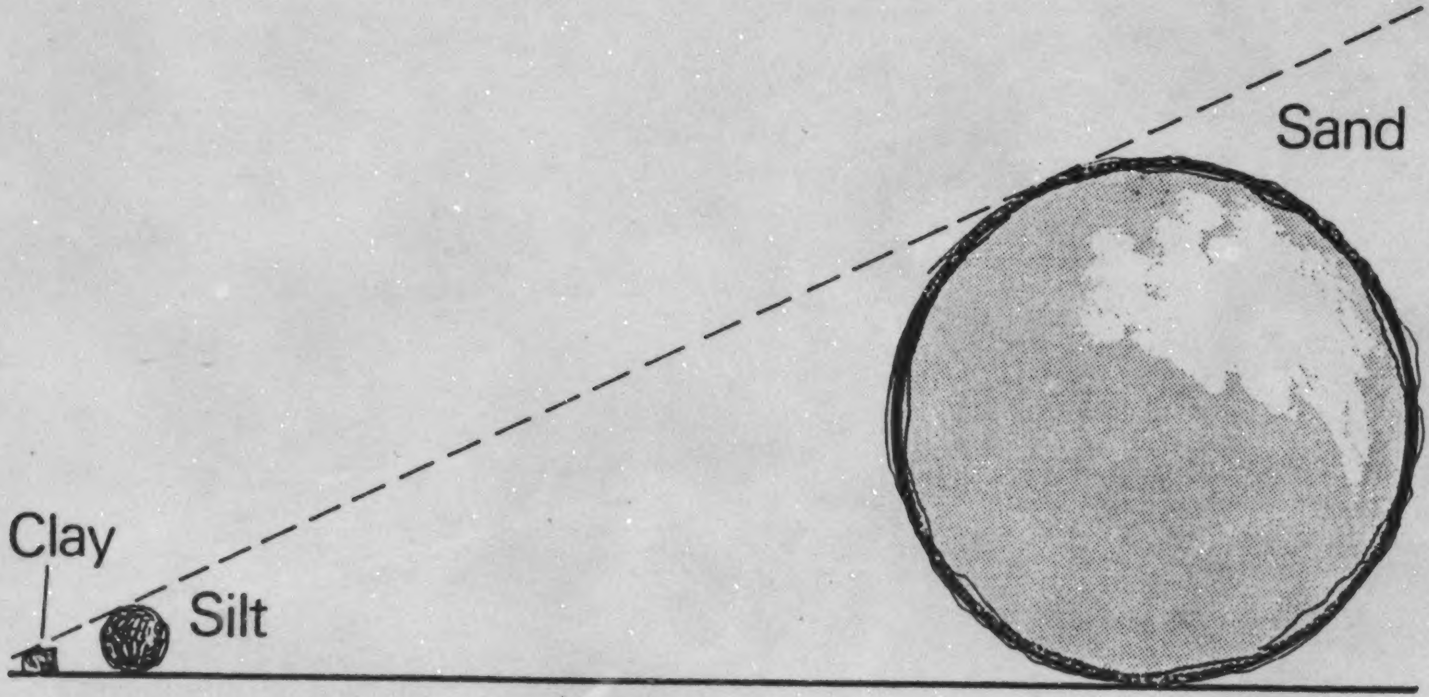


Rivers



Wind

Soil Particles


Sand
Clay
Silt

SOIL AND PLANT GROWTH MEDIA

UNIT 1

JOB SHEET #1: Determing Soil Texture by Feel.

I. Equipment and materials needed:

A. Several soil samples (from different locations).

B. Small container for water.

II. Observations:

A. Soils high in sand are seldom cloddy. They usually break apart easily.

B. Soils high in silt may be cloddy, but usually break suddenly to a soft powder showing a fingerprint.

C. Soils high in clay are usually cloddy and dry granules are often hard to break even with pressure.

III. Procedure:

A. Take about a half-tablespoon of one of the soils.

B. Moisten it gradually with a small amount of water.

C. Knead it vigorously until all the dry lumps are wetted (increase the amount of soil if too much water is used).

D. When all the soil is moist, test the ease of forming a ball, then try to squeeze the soil into a ribbon by working it between the thumb and forefinger.

E. Soils high in silt feel smooth and velvety, or floury, and usually show a finger print clearly.

F. They may form a short ribbon (depending upon the amount of clay in the sample).

G. Soils high in clay can often be pressed out into very thin ribbons two or more inches long.

RESULTS OF DETERMINING TEXTURE OF SOIL BY FEEL

No.	Soil Texture	Primary and Secondary Characteristics
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

SOIL AND PLANT GROWTH MEDIA

UNIT 1

JOB SHEET #2: Identify Various Sizes of Soil Particles

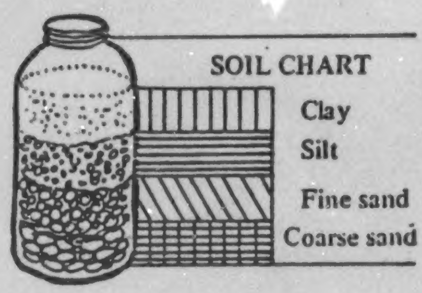
I. Equipment and Materials Needed:

- A. One quart mason jar.
- B. Sample of soil.
- C. Piece of cardboard paper.

II. Procedure:

- A. Fill the mason jar about two-thirds full of water.
- B. Pour in soil unitl the jar is almost full.
- C. Replace the cover or put one hard tightly over the top of the jar and shake it vigorously.
- D. Then put the jar on the table and let the soil settle.
- E. Allow plenty of time becuase the very small particles will be slow in settling.
- F. Hold the cardboard against the side of the jar and draw a diagram showing the different layers that have settled. The larger particles at and near the bottom are the sand particles. The finer particles directly above the sand are called the silt particles. The top layer of very fine particles consists of the clay in this soil.
- G. Particles are measured in millimeters (one-thousandth of a meter - a meter is apporximately 39 inches long) and are classified according to the following chart.

VERY COARSE SAND	2.0 to 1.0 mm
COARSE SAND	1.0 to 0.5 mm
MEDIUM SAND	0.5 to 0.25 mm
FINE SAND	0.25 to 0.10 mm
VERY FINE SAND	0.10 to 0.05 mm
SILT	0.05 to 0.002 mm
CLAY	smaller than 0.002 mm



III. What have you learned?

- A. Why is the size of soil particles important to the study of soils?
- B. How does the size of soil particles affect the ease of working soils?
- C. How does the size of soil particles affect the soil water and plant?

SOIL AND PLANT GROWTH MEDIA

UNIT I

TEST

1. Match:

______a. Properties
______b. Parent material
______c. Solum
______d. Aeration
______e. Inorganic
______f. Nature
______g. Soil
______h. Topography
______i. Organic
______j. True soil
______k. Tilth

1. The raw materials from which all soils are developed.
2. "Lay" of the land.
3. A characteristic attribute of a substance under stated conditions, especially in relation to the senses, as color, odor, hardness, etc.
4. A natural material occurring in a series of layers.
5. The character, constitution, or essential traits - original. The sum of physical or material existences and forces.
6. Non-living materials in the soil that come from either plants or animals.
7. Air in the soil.
8. The desirable, workable condition of the soil.
9. Material in the soil not the result of living or organic processes; not being animal or vegetable.
10. Combination of topsoil and subsoil.
11. Another name for "Solum."

2. List five factors responsible for the formation of soils.

3. Name three types of rocks from which parent material originates.

4. State at least two facts concerning climate in the formation of soil.

5. State at least two facts concerning plants and animals in the formations of soils.

6. State two facts concerning topography in the formation of soils.

TEST

7. Name three facts concerning time (age) in the formation of soils.

8. List three horizons found in a soil profile.

9. Fill in blanks below with "A", "B", or "C" depending upon which of the three horizons in a soil profile each statement applies to.

_____a. When combined with topsoil, it is called "solum."
_____b. Darkest in color.
_____c. Solum here may or may not have come from parent material.
_____d. Where most of bacteria, fungi, and insects are found.
_____e. Plant roots can grow deep enough to enter this layer.
_____f. A few inches to more than a foot deep.

10. Name four components of soil.

11. Fill in blanks with "M" for mineral matter, "O" for organic matter, "A" for air, or "W" for soil water, depending upon which of each statement below describes one or more of those soil components (NOTE: Some statements may apply to more than one component.)

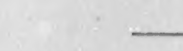
_____a. Makes up approximately 25% of the soil.
_____b. Located in the pore spaces between particles of soil.
_____c. Supports microorganisms in the soil.
_____d. Makes up about 45% of the soil.
_____e. Makes nutrients available to growing plants.
_____f. Adheres to soil particles.
_____g. Makes up from 1% to 5% of the soil.
_____h. Basically parent material.
_____i. Comprises the workable condition of the soil (tilth).

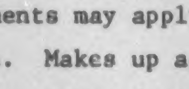
12. Name three classifications of water by how it is utilized in the soil.

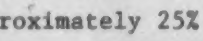
13. Name at least five of the classifcations of soil by texture.

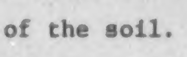
14. Define the "Hydrologic Cycle."

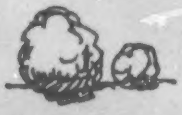
15. Identify at least five of the different kinds of soil structure illustrated below.

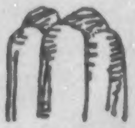

a. __________

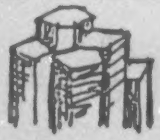

b. __________


c. __________


d. __________


e. __________


f. __________


g. __________

TEST

16. Perform job in Job Sheet 1 to the satisfaction of the instructor.
17. Perform job in Job Sheet 2 to the satisfaction of the instructor.

SOIL AND PLANT GROWTH MEDIA

UNIT 2

ORGANIC MATTER

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to organic matter; to state basic facts about organic matter including its importance in crop production; and to identify factors affecting the rate of decomposition, how nutrients obtained from organic matter affect soil, how organic matter in the soil is affected, what is the desirable percentage of organic matter for productive soils, how organic matter is lost from soil, how nutrients are released from the organic matter, and the kinds of organic matter that can be applied to soil. They will also be able to state facts about humus, name organic and inorganic mulches, and the purposes and timing of their use. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms pertaining to organic matter with their definitions.
2. State four important facts about organic matter.
3. State five kinds of importance of organic matter to crop production.
4. Name three factors affecting the rate of decomposition.
5. Name three basic ways in which nutrients obtained from organic matter affect soil.
6. State five factors affecting the soil organic matter.
7. State the desirable percentage of organic matter for productive soils.
8. Name four factors causing the loss or organic matter from soil.
9. State the name of the process that causes nutrients to be released from organic matter.
10. Name at least five types of organic matter that can be applied to soil.
11. Name at least four facts about humus.
12. Name at least six purposes of mulches.
13. Name four available organic and available inorganic mulches.
14. State at least six factors to consider when selecting mulching material.
15. State two times of the year when it is best to apply mulches.

SOIL AND PLANT GROWTH MEDIA

UNIT 2

INFORMATION SHEET

I. Terms and Definitions

A. Decomposition - The process of separation into constituent parts or elements by chemical action or natural decay.

B. Mineralization - A process by which organic matter is broken down into simple available mineral compounds.

C. C/N Ratio - Is the relationship between the amount or percentage of carbon to that of nitrogen in plant material.

D. Lignin - An organic substance which, with cellulose, forms the chief part of woody tissue. Makes up 40 to 45% of the total humus.

E. Compost - Is a mixture of soil and partly decayed organic matter or humus that is used to improve garden and potting soil.

F. Humus - The dark brown substance, the end product of decomposition, containing organic matter, that gives color and other properties to soil.

G. pH - A number used by chemists to indicate the relative amount of acid or alkali in a solution .

H. Denitrification - The release of nitrogen from a compound into the atmosphere as free nitrogen .

II. Important Facts about Organic Matter

A. Organic matter is non-living material in soil that comes from either plants or animals.

B. Organic matter can be found in all stages of decomposition.

C. Organic matter is one of the most important soil constituents.

D. Organic matter is the most easily depleted of the soil constituents.

III. The Importance of Organic Matter in Crop Production.

A. Increases moisture retention - in sandy or "light" soils.

B. Improves aeration - in clay or "heavy" soils.

C. Improves soil structure - in all types of soils.

D. Increases nutrient retention, and is a source of nutrients - in sandy or "light" soils.

E. Reduces water run-off and erosion - in clay or "heavy" soils.

IV. Factors Affecting the Rate of Decomposition

A. The nature of the plant material - Age and chemical composition determines its rate of decomposition .

INFORMATION SHEET

B. Soil conditions - Aeration, moisture, temperature, fertility and pH.

C. Climate - Moisture and temperature.

V. Nutrients Obtained from Organic Matter Affect Soil in Three Basic Ways

A. Chemically

1. Organic matter is a natural storehouse of nitrogen.
2. Upon decomposition of organic matter, the minerals are released in the soil solution.
3. Soil organisms will break down the nitrogen compound and release the nitrogen into the atmosphere as free nitrogen - called denitrification.
4. Some types of organic matter cause soil to be acid, others alkaline.

B. Physically (Most Important Effect)

1. Organic matter dilutes the soil.
2. Organic matter promotes granulation.
3. Organic matter aids in maintaining good soil-moisture-air relationships.
4. Organic matter reduces soil erosion.

C. Biologically (See TM 1)

1. Organic matter promotes and increases the soil organisms.
2. Organic matter provides soil organisms with the necessary food constituents for energy.
3. Organisms break down the organic matter, and acids are produced.
4. These acids aid in breaking down the mineral constituents of the soil - making them available for plant growth.
5. Soil microorganisms are more active than plants, so until decomposition is complete, they have first choice of available nutrients. If excess nutrients exist, the plants will get some; if not, both the microorganisms and the plants will suffer.

VI. Factors Affecting the Organic Matter in Soil

A. Climate - moisture, temperature, and growing season.

B. Vegetative cover - most of the organic matter in the soil comes from plant roots.

C. Drainage - good drainage increases decomposition of organic matter.

D. Topography - organic matter content is higher on flat land than on steep slopes.

E. Fertility - indirectly affects the accumulation of organic matter.

INFORMATION SHEET

VII. The Desirable Percentage of Organic Matter in Productive Soils is Approximately 4%

VIII. Factors Causing the Loss of Organic Matter from Soil

A. Decay

1. Environmental conditions suitable for quality plant growth is also suitable for decomposition of organic matter.
2. Fresh, succulent residues decompose rapidly and very little residue (humus) remains.
3. Mature plant material (e.g., straw) contains more lignin and, as a result are more resistant against breakdown.
4. Waxes and resins also decay very slowly.

B. Cropping

1. Clean-cultivation of crops encourages the decay of organic matter.
2. Cropping allows for adequate aeration and moisture so that decay can take place.

C. Erosion

1. Organic matter is light in weight; therefore, it is easily floated away on the surface of the runoff water.
2. Stopping runoff or slowing it down will reduce this loss to some extent.
3. Organic matter floated and deposited above plants will create mold.

D. Fire.

1. After a fire, organic matter that is left is generally lost by being swept away with the first rain.

IX. Nutrients in Organic Matter Are Released Through Mineralization

X. Types of Organic Matter That Can Be Applied to Soil

A. Crop residues

B. Manures

C. "Green-manure" (cover crops that are plowed under).

D. Grass clippings and leaves

E. Sawdust

F. Peat Moss

G. Compost

XI. Properties of Humus

INFORMATION SHEET

A. Humus is amorphous (literally, "bodyless;" means here "not constructed with crystals").

B. Humus remains in suspension in a liquid solution.

C. Per unit weight, humus is the most active percentage of all soil components.

   1. Humus has the ability to absorb large quantities of nutrients.
   2. It has the ability to absorb large quantities of water; more than its own weight.
   3. It prevents sudden chemical changes in the soil.

D. Humus is the principal stabilizer of soil physical structure.

E. Humus is relatively stable. It has C/N ratio of 10:1 (C/N = Carbon/Nitrogen).

F. Because it is slow to decompose, humus is the only stable storehouse of nitrogen in the soil.

G. Humus occurs as a thin film around the soil particles and creates aggregates .

XII. Mulches and Their Purposes

A. Mulches aid in maintaining soil organic water

B. Mulches promote soil granulation

C. Mulches serve as food for microorganisms

D. Mulches add some nutrients to the soil

E. Mulches aid in controlling weeds

F. Mulches help reduce soil compaction

G. Mulches provide an insulating effect

H. Mulches aid in conserving moisture

I. Mulches improve the quality of the crop product

J. Mulches aid in controlling soil erosion

XIII. Common Types of Mulches Available

A. Organic Types

   1. Shredded bark
   2. Peat moss
   3. Straw
   4. Leaves
   5. Wood chips
   6. Corn cob
   7. Compost

B. Inorganic Types

INFORMATION SHEET

1. Black plastic
2. Stones and pebbles
3. Aluminum foil
4. Shredded plastic

XIV. Factors to Consider When Selecting Material

A. Availability

B. Appearance

C. Effect on the soil

D. Acidity of its reaction

E. Rate of decomposition

F. Weed-free

G. Disease-free

H. Fire hazard

I. Resistance to blowing

XV. When To Apply a Mulch

A. Fall mulches delay soil cooling and freezing. Apply late fall.

B. Spring mulching delays soil warm-up. Apply late spring.

The Significance of Soil Organisms

Organism	Major Activity	Beneficial to Plant Growth	Harmful to Plant Growth
Earthworm	Mixes soil. Increases the availability of plant nutrients (especially nitrogen). Increases aeration. Promotes drainage.	X	X
Nematode	Penetrates plant tissue, especially roots, and causes extensive damage.	X	X (only about 50 of the thousands of nematodes known are harmful to plants.
Algae	Aid bacteria and fungi in the decomposition of plant tissue, in making nutrients available to plants.	X	
Fungi	Decomposes organic residues. Promotes the formation of humus. Causes many plant diseases.	X	X
Actnomycetes	Decomposes organic matter releasing plant nutrients; converts nitrogen from the air into a form available to plants (only certain bacteria are able to do this).	X	X
Bacteria	Decomposes organic matter, releasing plant nutrients, especially nitrogen. Causes plant disease.		X

TM 1

SOIL AND PLANT GROWTH MEDIA

UNIT 2

ASSIGNMENT SHEET #1: Field trip to study soils.

I. Do the Following:

   A. Visit a farm during plowing time. Discuss with the farmer the content of his field and how he maintains the pH level that he desires. Place findings below.

SOIL AND PLANT GROWTH MEDIA

UNIT 2

JOB SHEET #1: Determining Value of Organic Matter in the Soil.

I. Equipment and Materials Needed:

A. Two wide mouth jars

B. Small wire baskets of ¼ inch hardware screen

C. Lumps of soil

D. Water

II. Observations

A. Soils high in organic matter soak faster but hold more water

B. Soils low in organic matter tend to break into fine particles aiding erosion

III. Procedure:

A. Collect lumps of soil (not sandy soil) just under the sod from (1) a natural sod fence row and (2) a cultivated field that has been cropped continuously and where the soil is light in color. The lumps should be about twice the size of an egg.

B. Fill the jars with water within an inch from the top.

C. Place the lumps of soil in baskets and lower them slowly and gently into the jars.

D. Watch closely and note as many differences as possible between the two jars.

IV. What did you learn?

SOIL AND PLANT GROWTH MEDIA

UNIT 2

TEST

1. Match:

______a. Mineralization
______b. Lignin
______c. Compost
______d. C/N ratio
______e. Decomposition

1. The process to separate into constituent parts or elements by chemical action or natural decay
2. Is a mixture of soil and partly decayed organic matter or humus that is used to improve garden and potting soil
3. A process by which organic matter is broken down into simple mineral compounds which are then in an available form.
4. Is the relationship between the amound or percentage of carbon to that of nitrogen in the plant material
5. An organic substance which, with cellulose, forms the chief part of woody tissue. Makes up 40 to 45% of the total humus

2. State four important facts about organic matter.

3. State five kinds of importance of organic matter in crop production.

4. Name three factors affecting the rate of decomposition.

5. Name three basic ways in which nutrients obtained from organic matter affect the soil.

6. State five factors affecting the soil organic matter.

7. State the desirable percentage of organic matter for productive soils.

8. Name four factors causing the loss or organic matter from soil.

9. Nutrients that are tied-up in organic matter are released through a process called ________________________.

10. Name five types of organic matter that can be applied to soil.

11. Name at least four facts concerning humus.

12. Name at least six purposes of mulches.

13. a. Name four available organic mulches.
    b. Name four available inorganic mulches.

14. State at least six factors to consider when selecting material.

15. State two times of the year when it is best to apply mulches.

SOILS AND PLANT GROWTH MEDIA

UNIT 3

PLANT GROWTH MEDIA

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to plant growth media; to identify the common properties of all media mixes, the various types of media, the ingredients in various medium mixtures, and the characteristics of a good germination medium. Students will also be able to name and identify characteristics of a soilless, artificial medium mixture; and to state advantages of domestic peats. This objective will be considered achieved upon successful performance of the jobs assigned, and the attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that relate to plant growth media.
2. Identify as true or false given statements describing common properties of media.
3. List five types of plant growth media.
4. Name and identify the basic ingredients in the so-called "California" mixture, the "Texas A&M" mixture, and the "John Innes" mixture.
5. Name and identify ingredients used in the medium mixture for potting rooted cuttings and young seedlings, and those in the mixture for general container grown nursery stock.
6. Name two requirements of all plant growth media.
7. Name four characteristics of a good germination medium.
8. Name one soilless, artificial medium mixture and choose from given statements those that apply to such mixtures.
9. State two advantages and two disadvantages for using domestic peat in medium mix.
10. Compose soilless or artificial soil media.
11. Mix soilless or artificial soil media.

SOILS AND PLANT GROWTH MEDIA

UNIT 3

INFORMATION SHEET

I. Terms and Definitions

A. Media - Several ingredients mixed together that act or serve as an intermediary.

B. Aeration - Exposure to air.

C. Vermiculite - A mined micaceous mineral which expands when heat, neutral in reaction, insoluble in water, but capable of absorbing large quantities of water (3 to 4 gallons per cubic foot).

D. Dolomite limestone - A fertilizer consisting of calcium magnesium carbonate.

E. Super-phosphate - Calcium hydrogen phosphate and calcium sulphate in powder form, to be mixed with fertilizer. Contains 20% available phosphorus. Double or triple super phosphate contains 40% to 50% available phosphorus.

F. Perlite - A heat-treated material, like pumice, made of limestone. (CAUTION: Perlite may cause Flouride burn).

G. Chelate of Iron - A form in which iron can be readily available to plants when applied to the soil or sprayed on foliage.

H. Peat - A kind of turf made up of partly decomposed plant life, used as a mulching material, rooting medium, and a source of organic matter.

II. Common Properties of Media.

A. Sufficient firmness and density to hold cuttings or seeds in place.

B. Fairly constant volume whether dry or wet.

C. Sufficient retentiveness of moisture to reduce frequency of watering.

D. Sufficient porosity to enable excess water to drain off and to permit adequate aeration.

E. A pH level suitable to plant being grown.

F. Freedom from nematodes, seeds, weeds, and various noxious disease organisms.

III. Types of Media

A. Soil

B. Sand

C. Peat

D. Sphagnum moss

E. Vermiculite (tends to cake up with continued use)

F. Perlite (preferred over vermiculite)

G. Leaf mold (compost)

INFORMATION SHEET

H. Shredded bark, wood shaving, and sawdust

I. Well rotted manure

J. Volcanic rocks

IV. Some Recommended Mixtures

A. Mixture recommended by University of California

1. 50% fine sand (sterile and no clay)
2. 50% peat moss
3. This gives a maximum moisture-holding capacity of 48%

> NOTE: The above is for immediate use. If the California mix is to be stored for an indefinite time, add the following to each cubic yard: 4 oz. potassium nitrate, 4 oz. of potassium sulfate, 2-½lbs. mono-superphosphate, 7-½lbs. of dolomite lime, and 2-½lbs, calcium carbonate lime. If the mix is to be planted within one week of preparation, add the following to each cubic yard of mix: 2-½lbs. horn and hoof or blood meal (13%N), 4 oz. plus the above ingredients.

B. Mixture recommended by the Floriculture Department of Texas A&M University. (Makes one cubic yard)

1. 13.5 cu.ft. horticulture grade perlite
2. 13.5 cu.ft. sphagnum peat moss
3. 5.0 lbs. super-phosphate (20%)
4. 10.0 lbs. Dolomite
5. 5.0 lbs. Complete fertilizer (8-12-4 analysis)
6. 3.0 ox. Chelated iron
7. Mix ingredients thoroughly
8. This mixture is excellent when automatic watering and feeding facilities are available

C. Mixture recommended by the John Innes Horticultural Institution in England.

1. Potting compost
    - a. 7 parts loam (by volume)
    - b. 3 parts peat moss (by volume)
    - c. 2 parts clean sand (by volume)
    - d. To each cubic yard of mix add: 5 lbs. John Innes Base** and 1 lb. ground limestone
2. Seed compost
    - a. 2 parts loam (by volume)
    - b. 1 part peat moss (by volume)

**John Innes Base: 2 parts by weight horn and hoof meal; 2 parts by weight super-phosphate; and 1 part by weight potassium sulfate.

INFORMATION SHEET

c. 1 part clean sand (by volume)

d. To each cubic yard of mix add: 2 lbs. super-phosphate and 1 lb. ground limestone

V. Some Potting Mixtures for Different Situations

A. For potting rooted cuttings and young seedlings

1. 1 or 2 parts sand
2. 1 part loam soil
3. 1 part peat moss (or leaf mold)

B. For general container grown nursery stock

1. 1 part sand
2. 2 parts loam soil
3. 1 part peat moss (or leaf mold)
4. ½ part sawdust or wood shavings

VI. Basic Requirements for Any Mixture

A. Proper watering

B. Proper fertility

VII. Characteristics of a Good Germination Medium

A. Finely screened, yet porous, loose, open

B. One in which water flows quickly and easily

C. Low in nutrients

D. Sterilized

VIII. Soiless or Artificial Medium Mixture

A. Example: The Cornell Peat-lite Mix contains:

1. ½ cubic yard vermiculite No. 4 size
2. ½ cubic yard shredded moss peat
3. 5 to 10 pounds finely ground limestone
4. 1 pound of powdered 20% super phosphate
5. 2 to 12 pounds of 5-10-5 fertilizer

B. Some facts about soiless, artificial medium mixtures

1. Grower can obtain fairly reproducible results for his plants.
2. Trays containing this mixture are 50% lighter than the peat sand, loam mix.

INFORMATION SHEET

3. Iron deficiency often develops in this mix - solved by using ½ teaspoon of chelated iron in one gallon of water and applied as a spray.

IX. Advantages and Disadvantages of Using Domestic Peats for Medium Mix

A. Advantages

1. Large quantities available in the United States
2. Not as costly as the imported types
3. Trays containing peat (Soiless mix) are 50% lighter than peat, sand, loam mix.

B. Disadvantages

1. Variability in nutrient level, botanical composition, acidity, and the degree of decomposition.
2. Weed seeds, nematodes, and damping-off organisms and other soil-borne diseases are common problems with certain peat sources.

Suggested Micronutrient Mixtures for One Cubic Yard of Peat

COMPOUND	WEIGHT REQUIRED
Iron chelate or ferrous sulfate	50 grams (2 oz.)
Manganese sulfate	30 grams (1 oz.)
Copper sulfate	10 grams (0.3 oz.)
Zinc sulfate	6 grams (0.2 oz.)
Sodium borate (borax)	3 grams (0.1 oz.)
Sodium molybdate	1 gram (0.03 oz.)
Total mix	100 grams (3.6 oz.)

Analyses of Common Horticultural Peats

Type	Range in pH	Range of water absorbing capacity* per cent	Range in ash content* per cent	Range in Volume wts. lb./cu. ft.	Range in Nitrogen per cent
Sphagnum moss peat	3.0 – 4.0	1500 – 3000	1.0 – 5.0	4.5 – 7.0	0.6 – 1.4
Hypnum moss peat	5.0 – 7.0	1200 – 1800	4.0 – 10.0	5.0 – 10.0	2.0 – 3.5
Reed-sedge peat (low lime)	4.0 – 5.0	500 – 1200	5.0 – 15.0	10.0 – 15.0	1.5 – 3.0
Reed-sedge peat (high lime)	5.1 – 7.5	400 – 1200	5.0 – 18.0	10.0 – 18.0	2.0 – 3.5
Decomposed peat	5.0 – 7.5	150 – 500	10.0 – 50.0	20.0 – 40.0	2.0 – 3.5

*Oven-dry basis

Description of Various Peats

*1. MOSS PEAT – Formed principally from sphagnum, hypnum, and other mosses. Often called peat moss. Least decomposed of the various types of peat. Light tan to brown in color, light weight, porous, high in moisture holding capacity, high in acidity, and low in nitrogen.

2. HYPNUM MOSS PEAT – Darker brown in color, low acidity, formed from swamp plants. The moisture retention and nitrogen content is medium.

3. SPHAGNUM MOSS – Young residue or live portion of the plant called "top moss." It is marketed for tender plants for shipment and for starting root cuttings and seedlings and also for mulching.

*4. REED-SEDGE PEAT – Formed principally from reeds, sedges, marsh grasses, and other swamp plants. Peats of this type found on the market differ considerably in the degree of decomposition and acidity. Fibrous, reddish brown in color, medium nitrogen and moisture-retention capacity.

*5. PEAT HUMUS – Advanced stage of decomposition and in which the original plant remains are not identifiable. Usually derived from reed-sedge or hypnum moss peat. Dark brown to black in color, low moisture-retention capacity, and medium to high nitrogen content. Contains a high amount of lignin material. Most resistant to decomposition.

6. SEDIMENTARY PEATS – Found in the bottom of lakes and in the lower levels of most peat deposits. Derived from algae, plankton, pond weeds. Often contains marl and mineral soil impurities.

7. MUCK SOIL – Highly weathered peat that has been modified greatly by soil microorganism and is usually granular in structure. It has low moisture retention and is seldom recommended for soil improvements.

*Major types

TM 3

Recommended Uses and Application Rates for Different Types of Peat

Peat Use	Normal Application*	Sphagnum Peat Moss	Hypnum Moss Peat	Reed-sedge Peat	Peat Humus (decomposed)
Soil Conditioning	2" layer worked in soil	Fair	Good	Good	Good
Top-dressing lawn	1/8-1/4" layer worked in soil	Fair	Good	Good	Good
Surface mulch	2" layer	Excellent	Fair	Fair	Poor
Potting soil mix	50% peat 50% vermiculite or soil	Excellent	Good	Good	Fair
Golf green soil mix	80% sand 10% clay loam 10% peat	Poor	Good	Good	Excellent
Rooting Cuttings	50% peat 50% vermiculite	Excellent	Good	Fair	Poor
Seed Flat Germination	Pure milled peat	Excellent	Good	Fair	Poor
For acid-loving plants	25% mixture in soil	Excellent	Not recom'd.	Good if below pH 4.8	Not recom'd.
For acid-intolerant plants	in soil 25% mixture	Recom'd. only if limed	Good	Good if above pH 4.8	Good
Shipping tender plants	Wrap roots (wet)	Excellent	Fair	Fair	Poor
Adding stable organic matter	2" layer worked in soil	Poor	Fair	Good	Excellent
Liquid (litter)	2" layer on floor on floor	Excellent	Fair	Fair	Poor
Nitrogen source	Soil mixes top-dressing	Poor	Good	Fair	Good

*by volume

-TM 4

SOILS AND PLANT GROWTH MEDIA

UNIT 3

JOB SHEET #1: Composing Soilless or Artificial Soil Mixes

I. Equipment and Materials Needed:

A. Sufficient number of open containers such as pots, cans, or saucers.

B. Samples of each of the common soil additives. The following are suggested: sphagnum peat, reed and sedge peat, sphagnum moss, muck, manure, ground clay, silica (sharp) sand, beach sand, and cinders.

C. Labels for the samples.

II. Procedure:

A. The teacher will prepare all the samples, discuss them and place them on display.

B. Students will observe the samples and note the characteristics of each as brought out in the discussion.

C. The labels will be replaced with numbers and the students will verify their ability to identify each material.

SOILS AND PLANT GROWTH MEDIA

UNIT 3

JOB SHEET #2: Mixing Soilless or Artificial Soil Mixtures with Shovels

I. Equipment and Materials needed:

A. Component materials as specified by the teacher (use any of the mixes found in the Information Sheet).

B. Access to a large bench open on both sides or sufficient clean floor space.

C. Sufficient number of square-end, flat-bottom shovels.

II. Procedure:

A. According to specifications given by the instructor, teams of students will measure the amounts of the required soil components and place them in the mixing area in layers.

B. Two students will mix at one time. They are to stand opposite each other at one end of the pile and simultaneously shovel from the bottom of the pile within easy reach.

C. Students can rotate the shoveling so all can learn the procedure. The pile can be shoveled back to the original location and again to the other location until it is evenly mixed.

SOILS AND PLANT GROWTH MEDIA

UNIT 3

JOB SHEET 3: Mixing Soilless or Artificial Mixes with a Concrete Mixer

I. Equipment and Materials needed:

- A. Component materials as specified by the teachers.
- B. Watering can with sprinkler nozzle.
- C. Concrete mixer, 1-2cu.ft. capacity.
- D. Wheelbarrow.
- E. Shovel.

II. Procedure:

- A. According to specification by the teacher, place the amounts of the media components into the concrete mixer.
- B. Switch mixer on and let it turn until the mixture is well mixed. Turn Switch off.
- C. Test soil by feel for soil moisture. If it is too dry, sprinkle about one quart of water over the mix, repeat step 2 and test soil again. Repeat until the mix has the correct water content.
- D. Dump medium from mixer into the wheelbarrow.
- E. Place medium into storage bin or potting bench or mixing table to add fertilizer as directed by the teacher.

NOTE: If steamed ingredients are used, fertilizer (if needed) may be added in Step 1. Fertilizer should not be added to mixtures before steaming, because substances may be formed that are very harmful to plants.

If steamed ingredients are used, be sure that the concrete mixer, shovels, and wheelbarrow have been disinfected before use so the clean mix will not be contaminated.

SOILS AND PLANT GROWTH MEDIA
UNIT 3
TEST

1. Match:

______a. Aeration
______b. Dolomite limestone
______c. Perlite
______d. Chelate of iron
______e. Super-phosphate
______f. Peat
______g. Vermiculite
______h. Media

1. A kind of turf made up of partly decomposed plant life.
2. A heat-treated material, like pumice, made of limestone.
3. A fertilizer consisting of calcium magnesium carbonate.
4. Exposure to air.
5. Several things mixed together that act or serve as an intermediary.
6. A mined micaceous mineral which expands when heated.
7. Calcium hydrogen phosphate and calcium sulphate in powder form, to be mixed with fertilizer.
8. A form in which iron can be readily available to plants, when applied to the soil or sprayed on the foliage.

2. Identify as true or false each of the following statements describinng common properties of mixing media:

______1. Sufficient firmness and density to hold cuttings or seeds in place.
______2. Fairly constant volume whether dry or wet.
______3. A pH level suitable for plant being grown.
______4. Sufficient cloddiness so that the water will not drain off.
______5. Freedom of nematodes, seeds, weeds, and various noxious disease organisms.

3. List five types of media.

4. a. Name the two basic ingredients in the so-called "California mixture".

b. Identify by true of false each of the following ingredients that make up the medium mixture known as the "Texas A&M" mixture.

______1. 13.5 cu.ft. horticulture grade perlite.
______2. 13.5 cu.ft. sphagnum moss.
______3. 5 lbs. 20% super-phosphate.
______4. 10 lbs. Dolomite
______5. 6 lbs. coarse rocks.

TEST

_____6. 5 lbs. of complete fertilizer (8-12-4).

_____7. 3 oz. chelate of iron.

c. Name the two medium mixtures recommended by the John Innes Horticultural Institution in England, and their three ingredients.

5. a. List the three ingredients used in the medium mixture for potting rooted cuttings and young seedlings.

b. Identify as true or false each of the following ingredients that make up the misture for general container ground nurserystock.

_____1. 1 part sand.

_____2. 2 parts loam soil.

_____3. 1 part peat moss.

_____4. 3 parts nutshells.

_____5. ½ part sawdust or wood shavings.

6. Name two requirements of all media.

7. Name four characteristics of a good germination medium.

8. a. Name one soilless, artificial medium mixture.

b. Choose from the following statements those that apply to soilless, artificial medium mixtures.

_____1. Grower can obtain fairly reproducible results for his plants.

_____2. Iron never needs to be applied to this mixture.

_____3. Trays containing this mixture are 50% lighter than the peat, sand, loam mix.

9. a. State two advantages for using domestic peats in medium mixes.

b. State two disadvantages for using domestic peats in medium mixes.

10. Perform job in Job Sheet #1 to the satisfaction of the instructor.

11. Perform job in Job Sheet #2 to the satisfaction of the instructor.

12. Perform job in Job Sheet #3 to the satisfaction of the instructor.

SOIL AND PLANT GROWTH MEDIA

UNIT 4

MEDIA STERILIZATION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to soil sterilants, identify purposes, methods, problems, and sources of steam soil sterilization, and identify chemical fumigants and electrical sterilization. This objective will be considered achieved upon the attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that relate to soil sterilants.
2. Name three methods of sterilizing soil.
3. Name or identify given statements as true or false pertaining to the purposes and sources of steam sterilizing.
4. State at least four steps in preparing the soil for steaming.
5. State the length of time and temperature to steam soil.
6. State at least two problems that are likely to occur after steaming soil.
7. Identify as true or false given possible solutions to problems that may occur after steaming.
8. Identify as true or false given statements concerning the conditions under which soils are sterilized.
9. Name at least three chemical fumigants effective against fungi, bacteria, and nematodes.
10. Identify as true or false given names of fumigants that are particularly effective against nematodes.
11. Name five factors to consider in chemically fumigating soil.
12. List at least four forms in which chemical fumigants are applied.
13. List at least four precautions to observe in using chemical soil fumigants.
14. State two facts concerning electrical sterilization.

SOIL AND PLANT GROWTH MEDIA

UNIT 4

INFORMATION SHEET

I. Terms and Definitions

- A. Leaching - The dissolving-out of toxic materials from soil by running water slowly or percolating water through the soil.
- B. Sterilize - In horticulture, to heat soil just long enough to kill the harmful micro-organisms in the soil (soil is usable for planting two to three weeks after treatment).
- C. Sterilant - A chemical that kills all living things in the soil and renders soil unusable for plants for one to several years.
- D. Fumigant - A chemical whose vapors are capable of destroying soil-borne insects, bacteria, and weed seeds in an enclosed space.
- E. Nematode - A small round worm that lives in the soil and does much damage.
- F. Pasteurize - In horticulture, to heat soil just enough to kill selected bacteria.

II. Three Methods of Sterilizing Soil

- A. By steam
- B. By chemicals
- C. By oven heat

III. Sterilizing by Steam

- A. Purposes of steam sterilizing.
  1. To kill soil-borne insects.
  2. To kill all of the bacteria, fungi, and virus organisms that are harmful to commercial crops.
  3. To destroy weed seeds
  4. To promote soil granulation
- B. Sources of steam for soil sterilization
  1. Portable oil-fired steam boilers
  2. Existing steam boilers
  3. Packaged steamers
  4. Bricked-in permanent-type boilers

IV. Preparing the Soil for Steam Sterilization

- A. Add humus or organic matter
- B. Water the soil lightly

INFORMATION SHEET

1. Soil that is too dry will heat up slowly because of poor heat conduction and distribution.
2. Soil that is too wet will also heat up slowly because it requires considerable heat to heat a large quantity of water.

C. Keep the soil moist a week prior to steaming so as to encourage weed-seed germination (weeds will be easier to kill after germination).

D. Rototill and break up all lumps.

E. If soil in raised benches is being sterilized, unroll the canvas steaming hose down the length of the bench (ground beds may have buried tile for steaming purposes).

F. Cover the bench with a suitable cover - hold in place with "C" clamps.

V. Steaming the Soil - Steam the soil for thirty minutes at 180° to sterilize; 160° for thirty minutes to pasteurize.

VI. Possible Problems After Steaming

A. Soil may nitrify

B. Beneficial soil organisms may be killed

C. Ammonia may build up in the soil causing root burn

VII. Solutions to After-Steaming Problems

A. Use high-quality, long-lasting kinds of peat (such as German or Canadian sphagnum peats, or other forms of organic matter that break down slowly).

B. Avoid sterilizing in hot water.

C. Don't feed the previous crop after it shows color; leach it during the last waterings.

D. Keep soils cultivated during critical periods to encourage air to enter the lower soil.

E. Keep soil medium dry when steaming (sterilizing wet soils encourages the buildup of ammonia).

F. The addition of 4 lbs. of gypsum or 40% super-phosphate per 100 sq.ft. of soil immediately after steaming seems to help tie up free ammonia.

G. Leach heavily after steaming.

NOTE: Steam sterilization is highly effective and widely used in the greenhouse for controlling various soil-borne pests. It is also used to some extent in outdoor areas and for steaming bulk soils prior to use for growing plants.

INFORMATION SHEET

VIII. Sterilization by Chemicals (Fumigation)

A. Conditions under which chemical sterilization (fumigation) is most extensively used.

1. When overhead costs are so low that the time required for aeration is not expensive.
2. When weed seeds and soil-borne insects are the main reasons for sterilization.
3. When steam boilers are not available for sterilization.

IX. Some Chemical Fumigants Effective Against Fungi, Bacteria, and Nematodes

A. Methyl bromide

B. Chloropicrin (Tear Gas)

C. Mylone

D. Vapan or VPM

E. Vorlex

F. Trizone

G. Formaldehyde

X. Some Chemical Fumigants Particularly Effective Against Nematodes

A. Dichloropropene-dichloropropane mixtures

B. Ethylene di-bromide

XI. Factors to Consider in Chemically Fumigating Soil

A. Soil temperature

B. Soil moisture

C. Organic matter content

D. Soil texture

E. Soil type

F. Seals needed

G. Depth of application

XII. Forms in Which Chemical Fumigants Are Applied

A. Tractor-mounted equipment which lays a plastic film and injects the fumigant under the plastic cover.

B. Liquid water-miscible materials which are metered into sprinkler irrigation systems.

C. Granules, liquids, and powders which can be worked into the soil from equipment mounted in front of a rototiller.

D. Tractor-mounted chisel-tooth injection shanks can be used.

INFORMATION SHEET

E. Materials in pressure cylinders that can be released under plastic covers.

F. Hand-operated needle point injection guns can be used.

XIII. Precautions to be Observed in Using Chemical Soil Fumigants

A. No plants should be planted in fumigant-treated soil for two to three weeks.

B. Avoid inhaling the material.

C. Avoid contact of the fumigant with the skin.

D. Allow sufficient time for aeration after the material is applied.

E. Follow the instructions on the label.

XIV. Sterilization by Electricity (Oven Heat)

A. Electrical cables buried in ground and heated to the same degree as shown in TM 2.

B. Expensive installation, but it is relatively inexpensive to and easy to operate.

C. Sterilization box up to one cubic yard capacity. Heated electrically similar to oven to degrees show in TM 2.

Steam and Chemical Soil Sterilization

Treatment	Advantages	Disadvantages
STEAMING	A very effective job. Cost of treatment is less per acre than for chemicals.	High initial cost. Edges of benches and growing areas may not receive steam after steaming, problems frequently occur.
FUMIGATION (CHEMICAL)	Useful when a source of steam is not available. Gives good control of insects, weeds, and nematodes.	Cost of treatment per acre is high. Not very effective against hard-to-kill organisms. A great deal of time is required for aeration after treatment.

Killing Time for Various Soil Organisms when using Steam Sterilization (or "Pasteurization")

Organism	Time to Kill	Temperature
Nematodes	Instantly	140° F.
Soil Insects	Instantly	140° F.
Soil Fungi	10 minutes	140° - 160° F.
Soil Bacteria	10 minutes	140° - 160° F.
Weed Seeds	10 minutes	140° - 160° F
Soil Virus	30 minutes	180° F.

SOIL AND PLANT GROWTH MEDIA

UNIT 4

JOB SHEET #1: Steaming Soil.

I. Equipment and Materials Needed:

A. Growing medium

B. Steam hose

C. Steam generator (boiler).

D. Steaming tray, bin, bench, table, box, or trailer

E. Dial type probe thermometer ($0^\circ - 220^\circ F$)

F. Cover for steaming

G. Wooden Flats (if needed)

II. Procedure:

A. Test the soil for moisture content by squeezing it in your hand. It should hold a ball shape. If it is too wet, allow it to dry for several days. If it is too dry, sprinkle it with water and retest.

B. Place soil loosely in a greenhouse bench, on a canvas or the floor, or in flats for a steam box, or in the trailer.

C. Connect steam hose to steam outlet and place open end at the bench end, at the edge of the medium mound, or connect to steam box or trailer.

D. Place steaming cover over medium. Place a heavy chair, pieces of metal water pipe or other heavy objects near the edge of the covers. If a steam box is used, close cover tightly.

E. Slowly open steam valve to allow steam to inflate the cover enough to lift it off the medium surface. Adjust valve to hold the cover in this position. Too much pressure will blow off the cover. If a steam box is used, adjust the valve so only a little steam escapes from the cracks in the box.

F. Plunge the thermometer through the cover into the medium at the point farthest from the steam inlet. After the thermometer registers 180°, continue steaming for thirty minutes. The medium in the box should be steamed for a total of 45-60 minutes.

G. When the steaming time has ended, turn off the steam and remove the cover or open the door to the steam box. USE CARE - STEAM CAN SEVERELY BURN EXPOSED SKIN!

H. Plant in the medium only after it is cool to the touch.

SOIL AND PLANT GROWTH MEDIA

UNIT 4

TEST

1. Match:

______a. Sterilize

______b. Leaching

______c. Fumigant

______d. Nematode

______e. Sterilant

1. A chemical that kills all living things in the soil and renders the soil unusable for plants for one to several years.

2. The dissolving out of toxic materials from soil by running water or percolating water through the soil.

3. A small round worm that lives in the soil and does much damage.

4. A chemical whose vapors are capable of destroying soil-borne insects, bacteria, and weed seeds in an enclosed space.

5. To heat the soil just long enough to kill the harmful micro-organisms in the soil.

2. Name three methods of sterilizing soil.

3. a. Identify as true or false each of the following statements concerning the purposes of steam sterilizing.

_____1. Kill soil-borne insects.

_____2. Kill all of the bacteria, fungi, and virus organisms that are harmful to commercial crops.

_____3. Destroys weed seeds.

_____4. Promotes fertility in the soil.

_____5. Promotes soil granulation.

b. List at least three sources of steam.

4. State at least four steps in preparing the soil for steaming.

5. State the length of time and temperature to steam soil.

6. State at least two problems that are likely to occur after steaming soil.

7. Identify as true or false each of the following possible solutions to problems that may occur after steaming:

_____a. Avoid sterilizing in cold water.

_____b. Use high-quality, long-lasting kinds of peat such as German

TEST

or Canadian sphagnum peats, or other forms of organic matter that break down slowly.

_____c. Don't feed the previous crop after it shows color, and leach it during the last watering.

_____d. Keep soils cultivated during critical periods to encourage air to enter the lower soil.

_____e. Keep soils very dry when steaming.

8. Identify as true or false each of the following phrases concerning the conditions under which soils are sterilized by chemicals:

_____a. When overhead costs are so low that the time required for aeration is not expensive.

_____b. When weed seeds and soil-borne insects are the main reasons for sterilization.

_____c. When steam boilers are not available for sterilization.

_____d. During the war when poison gas is more available.

9. List at least three chemical fumigants effective against fungi, bacteria, and nematodes.

10. Identify as true or false each of the following fumigants that are particularly effective against nematodes:

_____a. Dichloropropene-dichloropropane mixtures.

_____b. Ethylene di-bromide.

_____c. Fly sprays.

11. Name at least five factors to consider in chemically fumigating soil.

12. List at least four forms in which chemical fumigants are applied.

13. List at least four precautions to observe in using chemical soil fumigants.

14. State two facts concerning electrical (oven heat) sterilization.

15. Job in Job Sheet #1 completed to the satisfaction of the instructor.

SOILS AND PLANT GROWTH MEDIA

UNIT 5

SOIL WATER AND IRRIGATION

TERMINAL OBJECTIVE

Upon completion of this unit, the students will be able to identify the principles and concepts associated with soil moisture and irrigation as it relates to media structure, texture, and permeability. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, the students will be able to:

1. Match terms and definitions concerning soil water and irrigation.
2. List three factors that determine the medium's water holding capacity.
3. Identify as true or false statements concerning facts relating to a medium's water holding capacity.
4. Explain the purpose of irrigation.
5. Name three types of irrigation systems and give an example of each.
6. State the rule of thumb concerning the availability of water in relation to soil structure.
7. Explain two factors concerning watering greenhouse and nursery plants.

SOILS AND PLANT GROWTH MEDIA

UNIT 5

INFORMATION SHEET

I. Terms and definitions:

1. Hygrosopic Water - The water or moisture so strongly attached to the medium particle that it is unavailable for plant use. (See TM 1)
2. Capillary Water - The water attached to the medium particle which is held by a force greater than the pull of gravity but still available to be used by the plants. This is the water plants depend on for their moisture. (See TM 1)
3. Gravitational Water - The water that drains through the medium because of the force of gravity. (See TM 1)
4. Saturation Point - All pore space in the medium is filled with water. The soil is as wet as it can be without water standing on the surface. (See TM 2, TM 3)
5. Field capacity - The point at which the medium contains the maximum amount of capillary and hygroscopic water; the greatest amount of water it can hold against the force of gravity. (See TM 2)
6. Wilting Point - The point at which there is not enough moisture available in the medium to allow plants to grow properly. (See TM 2)
7. Available Water - The amount of water a medium can hold between field capacity and the wilting point.
8. Evaporation - The moisture lost from the soil in the form of vapor.
9. Storage capacity - The amount of water a medium is able to hold; this is determined by soil texture.
10. Capillary action - The movement of water through microscopic pores in the medium due to the attraction of one water molecule to the other as well as to the medium particles disregarding the force of gravity.
11. Capillary Rate - The rate of movement of water through the medium; this is controlled by the structure and texture of the medium.
12. Irrigation - Supplying water to the medium by artificial means.
13. Precipitation - The supplying of water to the medium by rainfall or snowfall.
14. Water Table - The level at which the medium is saturated with water.
15. Permeability - The ability of water to penetrate into the soil.
16. Percolation - The process of passing through fine openings.
17. Permanent Wilting Point - The moisture content of a medium at which plants wilt and fail to recover when placed in a dark humid atmosphere.

II. Factors determining the medium's water holding capacity:

1. Texture

INFORMATION SHEET

2. Structure
3. Amount of organic matter present.

III. Facts concerning the medium's water holding capacity (See TM 4)

1. Clayey soils have the smallest particles and have the smallest pores.
    - A. Permeability is slow
    - B. Percolation is slow
    - C. Gives up water slowly to plants
    - D. High percent of water is hygroscopic water
    - E. Easy to over water
2. Sandy soils and media that have the largest particles have the largest pores.
    - A. Permeability is rapid
    - B. Percolation is rapid
    - C. Low per cent of water is hygroscopic
    - D. High per cent of water applied to soil is gravitational water.
    - E. Sandy soils are droughty soils
    - F. Easy to under water
3. Loamy soils and media that have medium sized particles have a mixture of large, medium, and small sized pores.
    - A. Permeability is variable;
    - B. Percolation is variable; depend
    - C. Has a favorable ratio of available water compared to hygrospic and gravitational water.
    - D. Easiest to manage for watering procedures.

IV. Purpose of Irrigation

1. To supply water to the growing media so that efficient plant growth may be maintained using artificial or non precipitation means.

V. Types of irrigation systems

1. Sprinklers - water under pressure is forced into the air through nozzles or perforation in pipes and falls as artificial rain.
2. Surface - Spreading water by ditch, gated pipe or flood irrigation.
3. Underground - water provided to plants by raising or creating a water table so that capillary action will feed the roots of the plants. This system uses deep ditches, tile, or perforated pipe.

4. Combination - the use of two or more of the above systems

VI. Rule of thumb concerning the availability of water in relation to soil structure

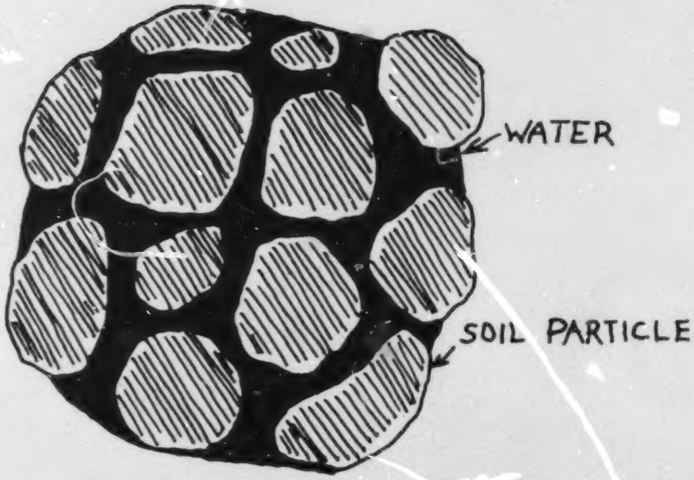
1. Generally the heavier the soil, the more inches of available water is present.

   (Note: This does not take into consideration organic matter influences or other soil and media additives.)

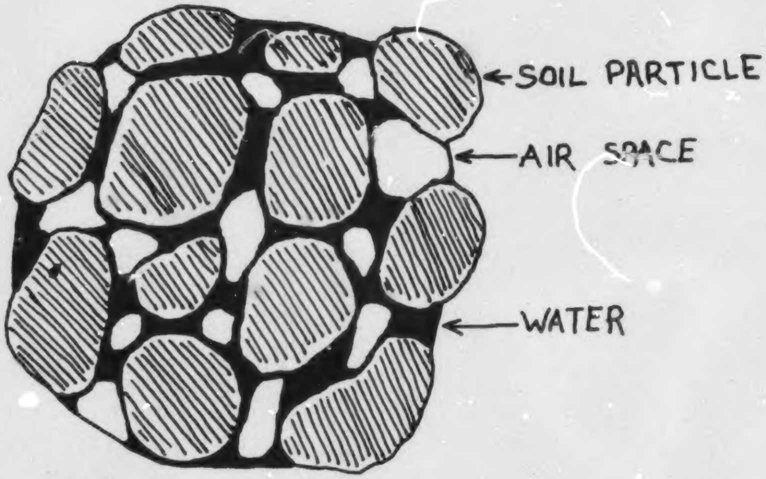
VII. Watering greenhouse and nursery plants.

1. Water only when surface of medium is dry to the touch.
2. Water thoroughly, approximately ten per cent of water applied should drain through the pot.

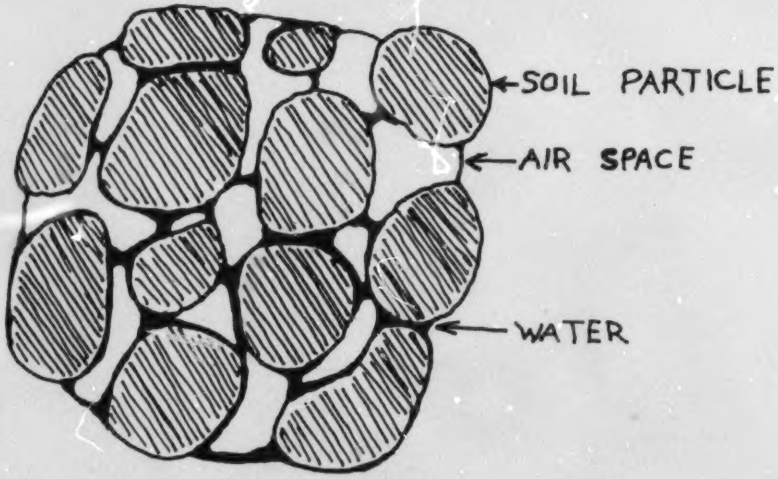
SOIL MOISTURE


WATER
SOIL PARTICLE

SOIL AT THE SATURATION POINT


SOIL PARTICLE
AIR SPACE
WATER

SOILS AT FIELD CAPACITY

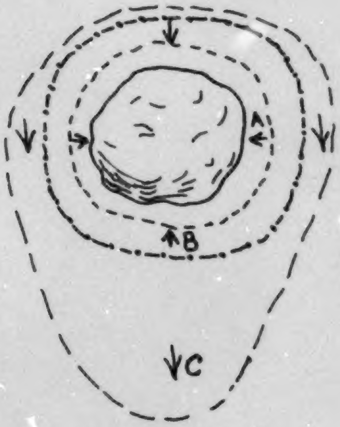

SOIL PARTICLE
AIR SPACE
WATER

SOIL AT THE WILTING POINT

WATER HOLDING CAPACITIES OF SOLIDS

TEXTURE OF SOIL (Entire Profile Approximately 6' deep)	Inches of Available Water at Field Capacity Acre (Acre-inch = 3,630 cubic feet)
Coarse Sand	4.50
Fine Sand	6.00
Fine Sandy Loam	9.00
Silt Loam	12.00
Clay Loam	13.00
Heavy Clay	12.00

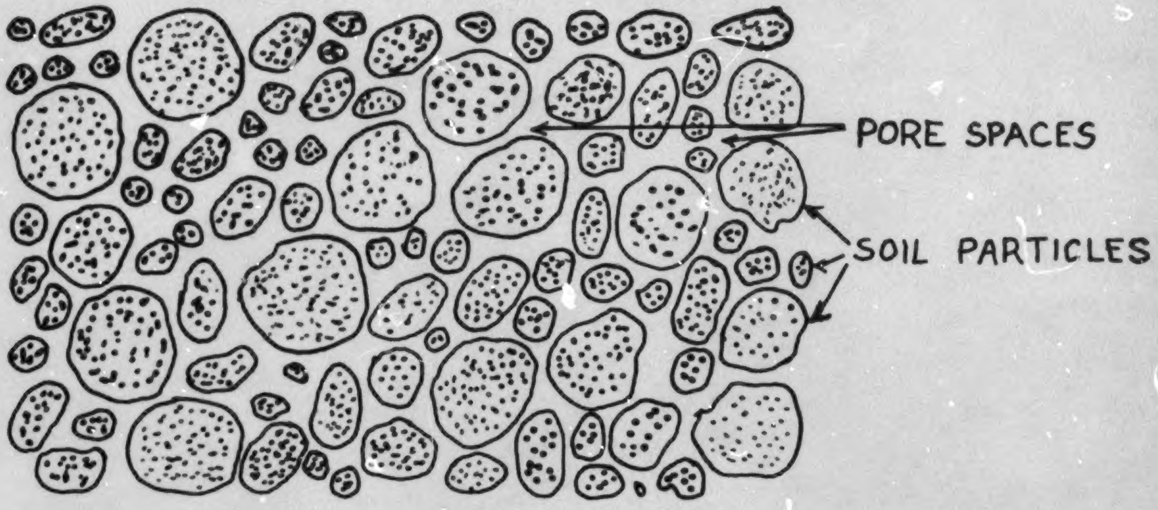
WATER HOLDING FORCES OF A SOIL PARTICLE



A. Hygroscopic Water - Water strongly attached to the soil particle.

B. Capillary Water - Water attached to soil particle with a force greater than gravity but weak enough to be used by plants.

C. Gravitational Water - Water not held to the soil particle-thus drains down through the soil.


PORE SPACES
SOIL PARTICLES

PORE SPACES

SOILS AND PLANT GROWTH MEDIA

UNIT 5

JOB SHEET #1: Soil Organic Matter and Soil Structure.

I. Materials Needed:

1. Two wide-mouth glass jars
2. Two small wire baskets of ½" hardware screen (3" x 10")
3. Lumps of various types of soil.

II. Procedure:

1. Make two small baskets or wire racks of the ½ inch hardware screen to fit into the wide-mouthed glass jars. For each rack you will need a piece of screen bent so that it extends down into jar.
2. Collect lumps of soil (not sandy) just under sod from (a) a natural sod fence row or park and (b) a cultivated field that has been cropped continuously and where the soil is light in color. The size of the lumps should be about twice the size of an egg.
3. Fill the jars with water within an inch of the top.
4. Place lumps of soil in the baskets and lower them gently into the jars.
5. Watch closely and make notes of what happens. Fill in information on the chart provided.

	Jar 1	Jar 2
Time to soak lump to saturation point		
Amount of erosion (Estimated %)		
Rate the ability of lumps to hold shape. (Excellent, Good, Fair, Poor)		

Questions:

Why does the soil from the heavily cultivated field fall apart and drop to the bottom of the jar while the other one holds its shape and clings together?

What did you learn?

SOILS AND PLANT GROWTH MEDIA

UNIT 5

TEST

I. Match the following terms and definitions:

_____A. Gravitational water
_____B. Wilting point
_____C. Percolation
_____D. Irrigation
_____E. Saturation point
_____F. Storage capacity
_____G. Capillary action
_____H. Available water
_____I. Permanent Wilting point
_____J. Permeability
_____K. Hygroscopic water
_____L. Evaporation
_____M. Water table
_____N. Field capacity
_____O. Capillary water
_____P. Precipitation
_____Q. Capillary rate

1. Supplying water to the medium by artificial means.
2. The amount of water a medium can hold between field capacity and wilting point.
3. The level at which the medium is saturated with water.
4. The processing of passing through fine openings.
5. The water or moisture so strongly attached to the medium particle that it is unavailable plant use.
6. The water that drains through the medium because of the force of gravity.
7. The moisture lost from the soil in the form of water vapor.
8. The moisture content of a medium at which plants wilt and fail to recover when placed in a dark humid atmosphere.
9. The amount of water a medium is able to hold; this is determined by soil texture.
10. The water attached to the medium particle which is held by a force greater than the pull of gravity but still available to be used by the plants. This is what water plants depend on for their moisture.
11. All pore space in the medium is filled with water. The soil is as wet as it can be without water standing on the surface.
12. The ability of water to penetrate into the soil.
13. The supplying of water to the medium by rainfall or snowfall.
14. The point at which the medium contains the maximum amount of capillary and hygroscopic water; the greatest amount of water it can hold against the force of gravity.
15. The rate of movement of water through the medium, this is controlled by the structure of the medium.

TEST

16. The movement of water through microscopic pores in the medium due to the attraction of one water molecule to the other as well as to the medium particles disregarding the force of gravity.

17. The point at which there is not enough moisture available in the medium to allow plants to grow properly.

II. List three factors that determine a medium's water holding capacity.

III. Identify as true or false the following statements relating to a medium's water holding capacity.

_____a. Loamy soils and media are the easiest to manage for watering procedures.

_____b. Permeability in clayey soils is rapid.

_____c. Percolation in loamy soils is variable.

_____d. Permeability in sandy soils is rapid.

_____e. There is a low percentage of water as hygroscopic water in sandy soils.

_____f. A high per cent of water applied to clayey soils is gravitational water.

_____g. Loamy soils have the greatest amount of small particles.

_____h. Perculation of water in clayey soils is slow.

_____i. Loamy soils have a favorable ratio of available water compared to hygroscopic and gravitational water.

_____j. Sandy soils have the largest individual pore spaces.

_____k. Clayey soils have a mixture of large, small and medium sized particles.

_____l. Clayey soils are the easiest soils to underwater.

_____m. Sandy soils are considered droughty soils.

_____n. Clayey soils give up water slowly to plants.

IV. Explain the purpose of irrigation.

V. Name three types of irrigation systems and give an example of each.

VI. State the rule of thumb concerning the availability of water in relation soil structure.

VII. Explain two factors concerning watering greenhouse and nursery plants.

VIII. Complete Job Sheet #1 to the satisfaction of the instructor.

FERTILIZERS

UNIT 1

INTRODUCTION TO FERTILIZERS

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to identify deficiency symptoms of the major plant nutrients while observing the growing plant. The sutdent will be able to take soil test information and determine the amount of fertilizer to use. This objective will be considered achieved through demonstration and scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms associated with fertilizers to the correct definition.
2. Name five factors that influence the use of fertilizers.
3. List the sixteen elements known to be essential for plant growth and name the correct chemical symbol for each.
4. Name the three major (primary) plant nutrient and anme three characteristics of each.
5. Name three minor (secondary) plant nutrients and name three characteristics of each.
6. Name three micro-elements necessary for plant growth which are usually found in sufficient quantity in most soils.
7. Name the requirements that must be stamped on fertilizers bags according to state law.
8. Classify fertilizers according to ordinary, high analysis, or concentrated.
9. Define dry, liquid, gas, and water soluble slow release fertilizer.
10. Discuss in a short paragraph what 20-10-10 means according to fertilizer analysis.
11. Match descriptions of hunger signs of plants with the deficient plant food element.
12. Identify the parts of the pH scale and, by reading soil test information, determine if the soil is acid, neutral, or alkaline.
13. Name three ways liming benefits plant growth.
14. Match plants to the most desirable pH scale range.
15. Classify fertilizers according to their percent nutrient value from the highest percent to the lowest.
16. Name four factors to consider in caring for fertilizer equipment.

SPECIFIC OBJECTIVES

17. Name three factors to consider in storing fertilizer.
18. Calculate problems comparing the cost per pound of nitrogen for each fertilizer.
19. Calculate problems determining application rates of fertilizers.
20. Demonstrate the ability to interpret a soil test and recommend the fertilizer to use and the amount.
21. Calculate problems determining rate of the lime application.
22. Match description of fertilizer application with methods of field applications.

FERTILIZERS
UNIT 1
INFORMATION SHEET

I. Terms and Definitions

A. Formula - The quantity and grade of materials used in making a fertilizer mixture.

B. Fertilizer - Any natural manufactured or processed material or mixture of materials that contains one or more of the recognized plant food elements, either liquid or dry.

C. Ratio - The ratio of nitrogen, phosphate, and potash in a fertilizer.

D. Grade - The total of the fertilizer analysis.

E. Analysis - The percent content of total (N) nitrogen available (P) phosphorus expressed as P_2O_5 and the amount of water soluble (K) potassium expressed as K_2O.

F. Brand - Trademark of the company which produced the fertilizer.

G. Carrier - A fertilizer containing only one nutrient.

H. Complete fertilizer - One which supplies all three of the major nutrients.

I. Mixed fertilizer - A mixture of two carriers.

J. Filler - The material added for weight to the fertilizer which does not contain n, P_2O_5 or K.

K. Conditioner - The material added to the fertilizer in order to improve its physical condition.

L. Acid soil - The soil having an acid reaction; the pH below 7.0

M. Alkali soil - The soil that contains enough exchangeable sodium to adversely affect the growth of most crops

N. Alkaline soil - The soil having a basic reation; the pH above 7.0.

O. Organic soil - A term used to refer to soils containing 20% or more organic matter.

(NOTE: Average of most Kansas soils is 5%)

P. pH - A terms used to indicate the degree of acidity of alkalinity of the soil.

Q. Yield possibility - The yield obtained for a given cropping situation when all nutients are adequate.

R. Percent sufficient - The percent of the yield possibility obtained because of the deficiency of a plant nutrient.

S. Primary nutrients - The three major plant nutrients N, P, K

T. Secondary nutrients - Three minor plant nutients (Calcium, magnesium and sulfur)

U. Effective Calcium carbonate (ECC) - The neutralizing capacity of Ag lime in relation to pure 100% calcium carbonate.

INFORMATION SHEET

II. Factors Influencing Use of Fertilizers
- A. Crops
  - 1. Value
  - 2. Leaching of nitrogen
  - 3. Absorbing ability
- B. Chemical condition of soil
  - 1. Availability of total nutrients
  - 2. Availability of nutrients
- C. Physical condition of soil
  - 1. Moisture content
  - 2. Soil texture (aeration)
- D. Insects and diseases
- E. Climatic conditions

III. Essential Elements (TM 1)
- A. Carbon - C
- B. Hydrogen - H
- C. Oxygen - O
- D. Nitrogen - N
- E. Phosphorus - P
- F. Potassium - K
- G. Calcium - Ca
- H. Magnesium - Mg
- I. Sulfur - S
- J. Iron - Fe
- K. Zinc - Zn
- L. Manganese - Mn
- M. Copper - Cu
- N. Boron - B
- O. Molybdenum - Mo
- P. Chloride - Cl

IV. Characteristics of Major Plant Nutrients
- A. Nitrogen
  - 1. Part of every living cell
  - 2. Part of the chlorophyll molecule

INFORMATION SHEET

3. Gives dark green color
4. Aids and promotes seed development
5. Easily translocated

B. Phosphorus
1. Part of every living cell
2. Contributes to early maturing of crops
3. Necessary for seed formation
4. Stimulates root growth
5. Easily translocated

C. Potassium
1. Necessary for production and translocation of carbohydrates
2. Aids in respiration
3. Controls water intake and respiration
4. Easily translocated
5. Promotes health and vigor to plants
6. Stiffens straw and stalks

V. Characteristics of Minor Plant Nutrients.

A. Calcium
1. Speeds decay of organic matter
2. Stimulates formation of nitrates
3. Promotes root and leaf growth
4. Necessary for nodulation of legumes

B. Magnesium
1. Necessary for chlorophyl or green coloring
2. Increases absorption of phosphorus
3. Aids in formation of fats and oils
4. Important in plant enzyme system

C. Sulfur
1. Necessary for nodule formation on legumes
2. Associated with plant enzyme systems
3. Easily translocated

INFORMATION SHEET

VI. Micro-elements.

A. Manganese

B. Boron

C. Copper

D. Zinc

E. Iron

VII. Fertilizer Bag Requirements (TM 2)

A. Name, brand, or trademark

B. Analysis (guaranteed or chemical composition)

C. Net weight

D. Name and address of manufacturer

VIII. Fertilizer Classification.

A. Ordinary - Less than 20% plant food

B. High analysis - 20% to 30% plant food

C. Concentrated - Over 30% plant food

D. Examples

1. 0-20-0 - High
2. 20-20-20 - Concentrated
3. 82-0-0 - Concentrated
4. 5-10-0 - Ordinary

IX. Fertilizers

A. Dry mixed - A granulated fertilizer made by combining selected plant food materials to obtain certain ratios and quantities of plant nutrients.

B. Liquid - a liquid fertilizer made by dissolving the correct proportion of the solid plant food carriers into water or by the neutralization process of neutralizing phosphoric acid with ammonia.

C. Gas - A liquid fertilizer containing solid fertilizer materials which is dispersed under pressure and usually contains a higher analysis than clear liquid mixes.

X. Fertilizer Analysis (TM 3)

A. Consists of three figures

(NOTE: These three figures indicate the plant nutrient content of of the material).

INFORMATION SHEET

B. First figure - Represents pounds of total nitrogen available in 100 pounds of fertilizer.

C. Second figure - Represents pounds of total phosphorus available expressed as P_2O_5.

D. Third figure - Represents pounds of water soluble potash expressed as K_2O.

E. Example - 100 pounds of 20-10-10 fertilizer

1. 20 pounds of total nitrogen
2. 10 pounds of available phosphorus
3. 10 pounds of water soluble potash

XI. Description of Hunger Signs of Plants

A. Nitrogen

1. Stunted and spindly
2. Yellowish-green foliage
3. Older leaves affected first
4. Leaf margins remain green

B. Phosphorus

1. Stunted growth
2. Abnormally green appearance
3. Leaves become purple in advanced stages
4. Older leaves affected first

C. Potassium

1. Shorter plants
2. General loss of green color
3. Leaf margins affected first

D. Magnesium

1. General yellowing
2. Older leaves affected first
3. Leaves become reddish-purple in advanced stages, especially leaf edges
4. Veins remain green
5. Leaves may curl downward

XII. pH Scale (TM 4)

A. Acid - 0 to 6.9

INFORMATION SHEET

B. Neutral - 7.0

C. Alkaline - 7.1 to 14.0

(NOTE: The pH scale is divided into 14 divisions, or pH units. Soils with a pH value of 7.0 are neutral; those with a value below 7.0 are said to be acid, while those above 7.0 are alkaline. A pH of 5.0 is 10 times more acid than a pH of 6.0, and a pH of 4.0 is 10 times as acid as pH 5.0, or 100 times as acid as one with a pH of 6.0. The pH value of most soils falls in the range between 4.0 and 8.0. A pH of about 6.5 is considered desirable for most plants.)

XIII. Liming Effects on Plant Growth (TM 5)

A. Corrects soil acidity

B. Reduces solubility of toxic elements

C. Supplies calcium and magnesium

D. Improves biological activity

E. Improves physical condition of soil

F. Makes fertilizers more effective and efficient

G. Improves yields

XIV. Desirable Plant pH Scale (TM 6)

A. Strongly acid 5.0 to 5.5

1. Potatoes
2. Watermelon

B. Medium and moderately acid 5.5 to 6.5

1. Soybean
2. Corn
3. Wheat
4. Sorghum
5. Vetch
6. Oats
7. Rye
8. Millet
9. Sudangrass
10. Cotton
11. Peanuts
12. Bermudagrass

INFORMATION SHEET

C. Slightly acid - slightly alkaline 6.5 to 7.5
  1. Alfalfa
  2. Sweet clover

XV Fertilizer Nutrient Value Classification

A. Nitrogen
  1. Anydrous ammonia 82% 82-0-0 grade
  2. Urea 45% 45-0-0 grade
  3. Ammonia nitrate 33% 33-0-0 grade
  4. Ammonia sulfate 21% 21-0-0 grade
  5. Urian 28% 28-0-0 grade

B. Phosphate
  1. Phosphoric acid 50-54% 0-54-0 grade
  2. Cons. Superphosphate 44-48% 0-45-0 grade
  3. Ammonium phosphate 35-35% 18-46-0 grade
  4. Rock phosphate 30-34%
  5. Nitric phosphate 10-20% many grades

C. Potash (Potassium)
  1. Muriate of potash 60-63% 0-0-60 grade
  2. Potassium sulfate 50-53% 0-0-50 grade
  3. Potassium nitrate 44-46% 13-0-44 grade

XVI. Care of Fertilizer Equipment

A. Remove all fertilizer from hopper after use

B. Clean hopper thoroughly with water

C. Allow hopper to dry

D. Apply a mixture of 50% kerosene to hopper

XVII. Storage of Fertilizer

A. Store in a dry location

B. Do not stack in direct contact with walls

C. Do not stack directly on concrete floor

(NOTE: If storage location has a concrete floor, use lumber and construct a false floor.)

INFORMATION SHEET

XVIII. Application of Fertilizers. (TM 7,8,9,10)

A. Banding

1. Band of fertilizer placed 2 to 3 inches to the side of the seed.
2. Band of fertilizer placed 3 to 6 inches below the seed.
3. Increases the efficiency of phosphorus.

B. Topdressing

1. Nutrients are supplied to small grains, legumes and grasses by drilling them into the topsoil.
2. A drill attachment is used to supply fertilizer.
3. Topdressing small grains is similar to side dressing row crops.

C. Sidedressing

1. Restricted to the application of nitrogen and potassium.
2. Fertilizer can be applied 2-4 weeks after planting.
3. Apply between rows usually the same time as first cultivation.

D. Broadcasting

1. Fertilizer is applied uniformly over the surface of the land.
2. Apply before planting.
3. Can be incorporated into the soil by disking.
4. Decreases the efficiency of phosphorus.

E. Applying in Irrigation Water

1. Fertilizer is metered into irrigation water for even distribution.
2. Efficient process of applying nitrogen.
3. Not recommended for phosphorus because it tends to remain on the surface.

F. Foliage Spray

1. Nutrients are deposited by a liquid/spray on the leaves of the plants.
2. Satisfactory for applying most trace elements.
3. Not recommended for major element due to the large amount needed by the plant.

G. Aerial Application

1. Fertilizer is applied by airplane.
2. Considered a form of broadcast application.
3. Useful in area with rough or wet land and forests.

4. Usually coarse, granular or pelleted material is used for aerial distribution.

XIX. Calculating Cost of Nitrogen

A. Multiply percent nitrogen x 2000 lbs/per ton.

B. Divide pounds of nitrogen in one ton into the cost per ton.

C. Example ($68.00 per ton)

33.0% nitrogen in 100 pounds

x 20 100-pound bags in a ton

660.0 pounds of nitrogen in one ton

$$660\,\overset{.1030}{\overline{)\,68.00}} \text{ - 10.3 cents per pound}$$

XX. Calculating Application Rates

A. Determine pounds of nutrient needed.

B. Divide by percent of nutrient in fertilizer.

C. Example

$$\frac{\text{40 lbs. of K20 Needed}}{\text{50 percent K20 in fertilizer}} \text{ - 80 lbs. of 0-0-50 needed per acre}$$

XXI. Calculating Liming Rate

A. Obtain recommended lime requirement from soil test.

B. Obtain the percent effective calcium carbonate (ECC) at time to be used.

C. Example

Soil test - 6000 pound of ECC Lime dealer's guarantee - 60 percent ECC

$$\frac{6000}{.60} \text{ - 10,000 pounds or 5 tons per acre Ag lime application}$$

XXII. Understanding Lime Requirements

A. Amount of lime needed depends on several factors.

1. Amount of clay (texture)
2. Type of clay (structure)
3. Organic Matter

B. Soil test is the only accurate method of determining lime needs.

INFORMATION SHEET

(NOTE: A basic pH test should not be used to compute lime requirements, but can indicate the need for an accurate soil test and lime requirement analysis from official soil testing laboratories.)

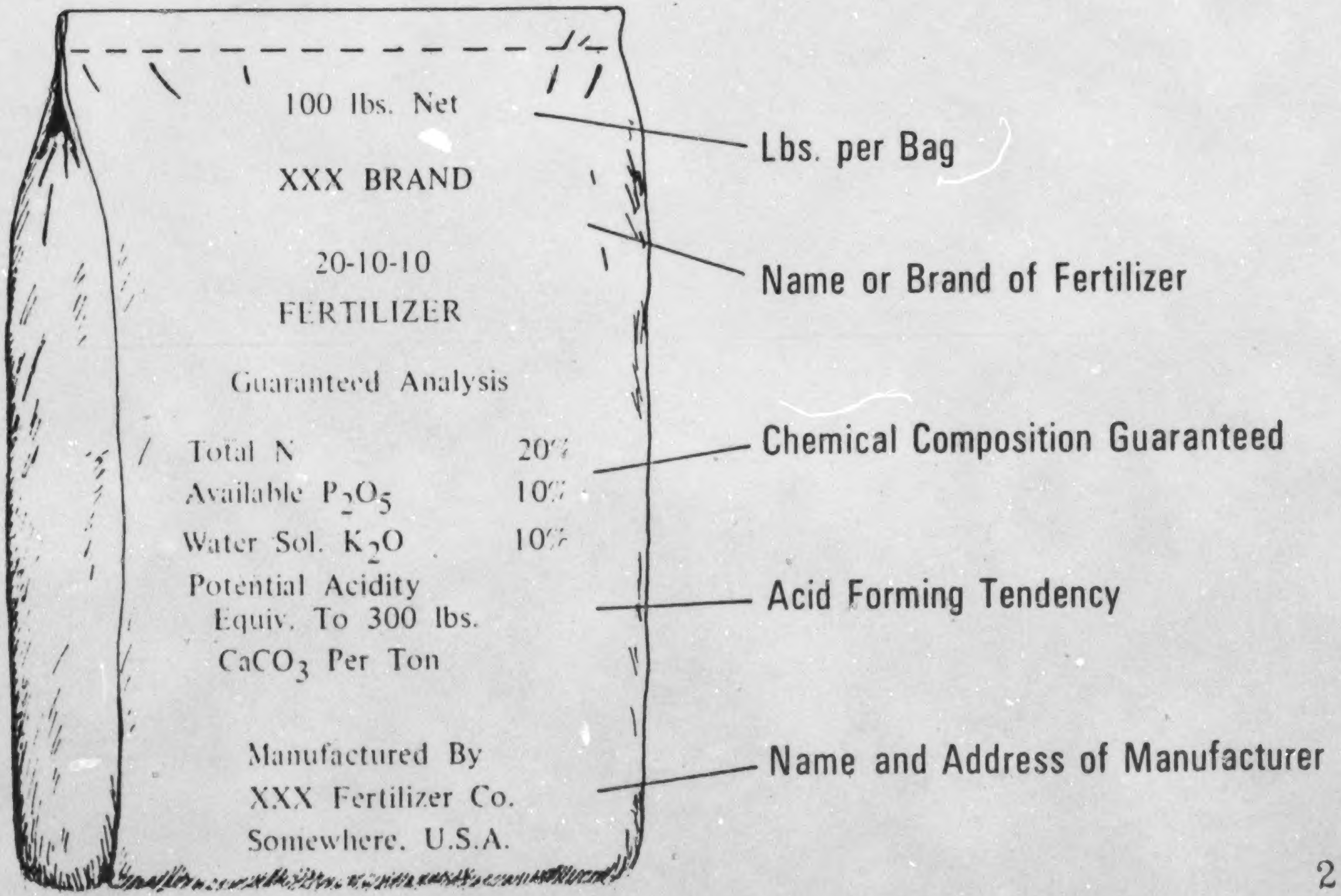
Essential Elements

NON MINERAL	PRIMARY	SECONDARY
Carbon	Nitrogen	Calcium
Hydrogen	Phosphorus	Magnesium
Oxygen	Potassium	Sulfur

MICRO-ELEMENTS

- Iron
- Chloride
- Manganese
- Boron
- Zinc
- Copper
- Molybdenum

Required Fertilizer Bag Information


100 lbs. Net
XXX BRAND
20-10-10
FERTILIZER
Guaranteed Analysis
Total N 20%
Available P_2O_5 10%
Water Sol. K_2O 10%
Potential Acidity
Equiv. To 300 lbs.
$CaCO_3$ Per Ton
Manufactured By
XXX Fertilizer Co.
Somewhere, U.S.A.

Lbs. per Bag

Name or Brand of Fertilizer

Chemical Composition Guaranteed

Acid Forming Tendency

Name and Address of Manufacturer

Fertilizer Analysis

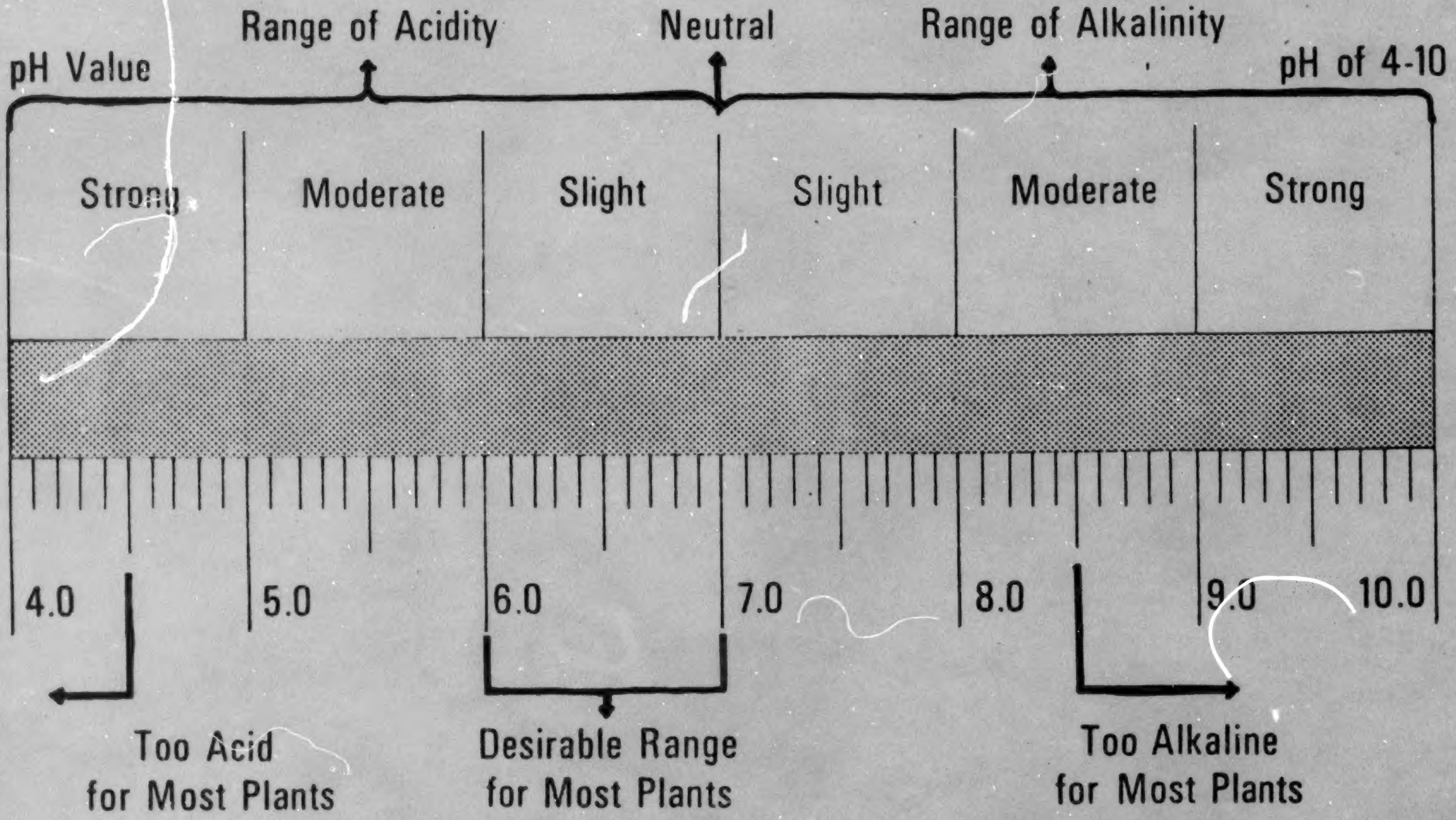
20 – 10 – 10

↑ Total Nitrogen Available

↑ Total Phosphorus Expressed as P_2O_5

↑ Water Soluble Potash Expressed as K_2O

pH Scale



pH Value

Range of Acidity

Neutral

Range of Alkalinity

pH of 4-10

Strong

Moderate

Slight

Slight

Moderate

Strong

4.0

5.0

6.0

7.0

8.0

9.0

10.0

Too Acid
for Most Plants

Desirable Range
for Most Plants

Too Alkaline
for Most Plants

TM 4

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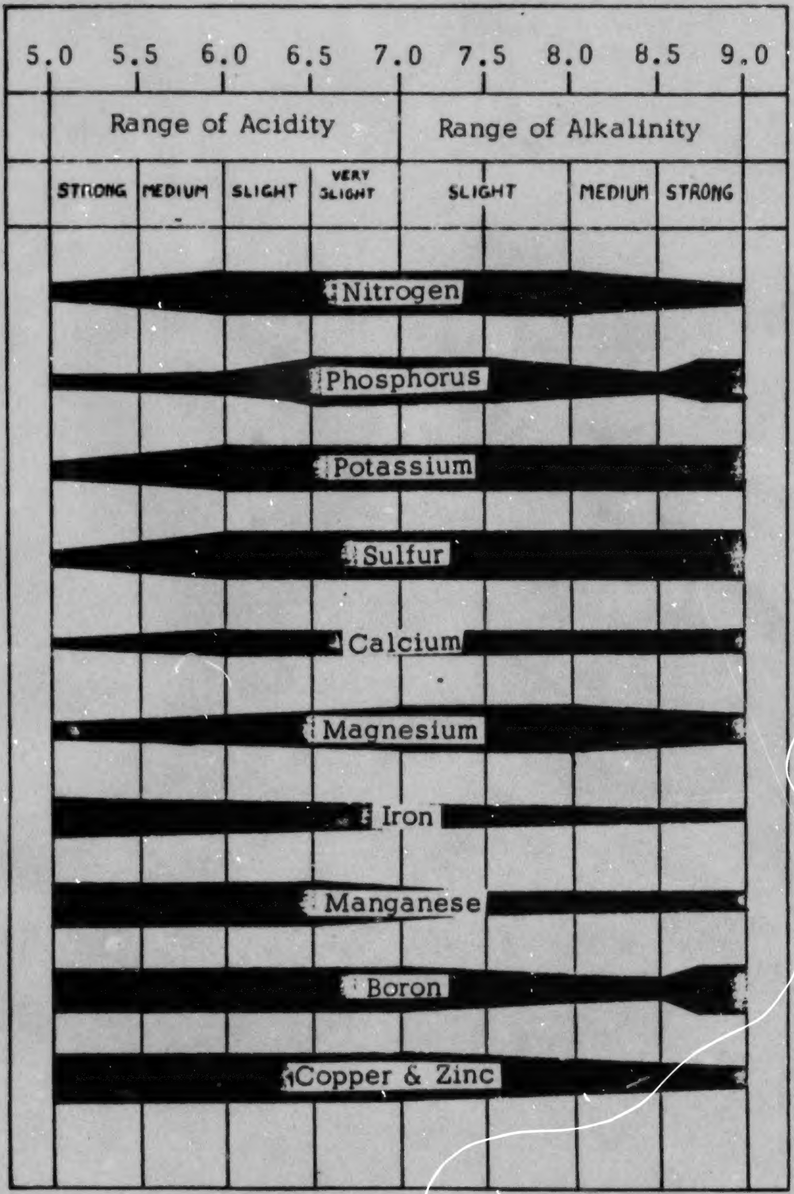
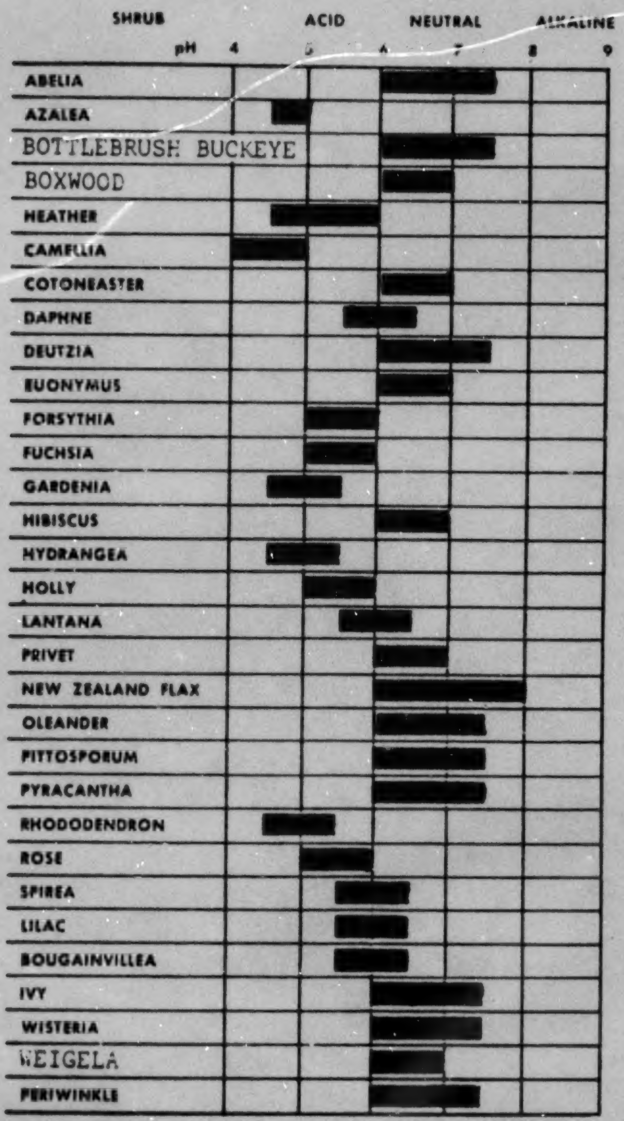
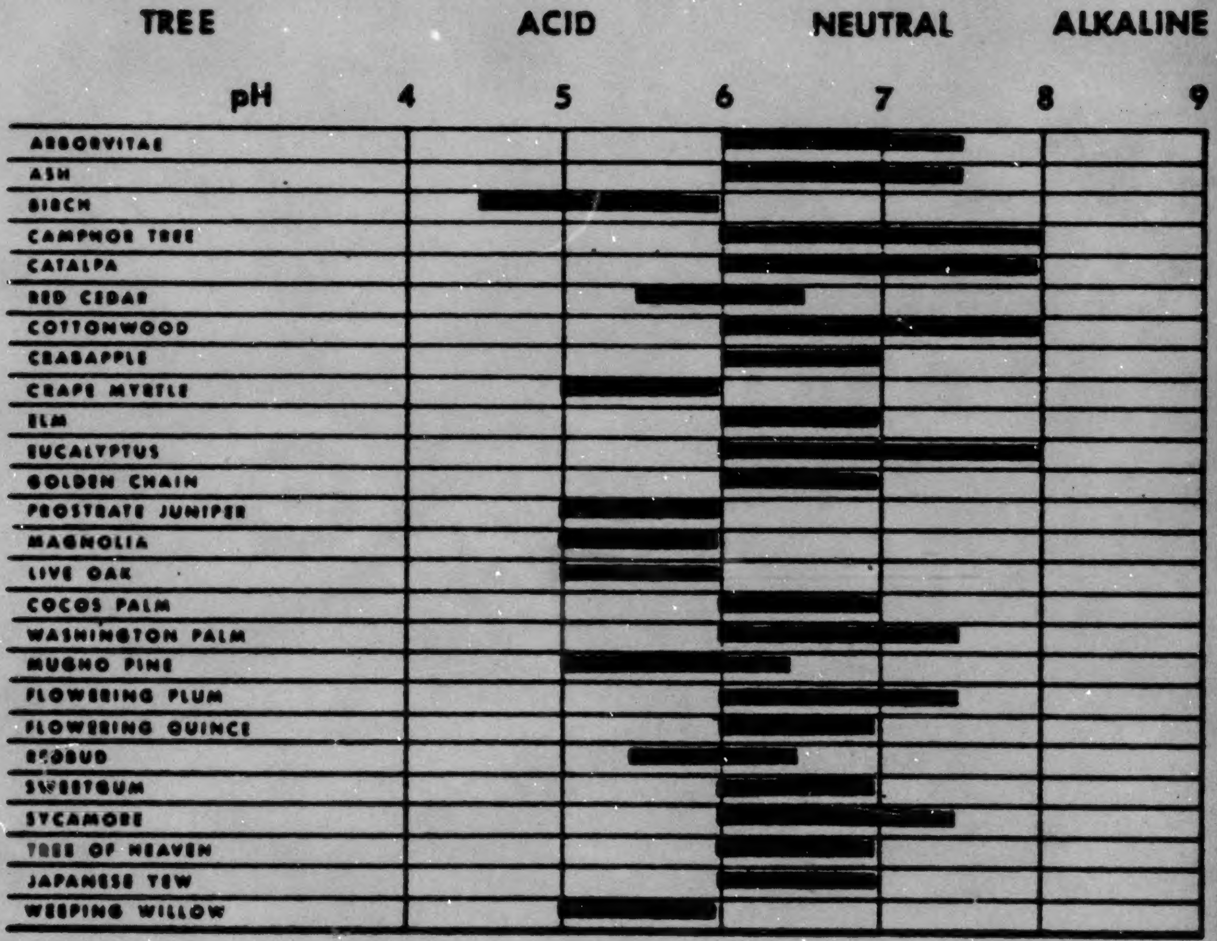
AVAILABILITY OF NUTRIENTS TO PLANTS AT DIFFERENT pH LEVELS IN MINERAL SOILS.



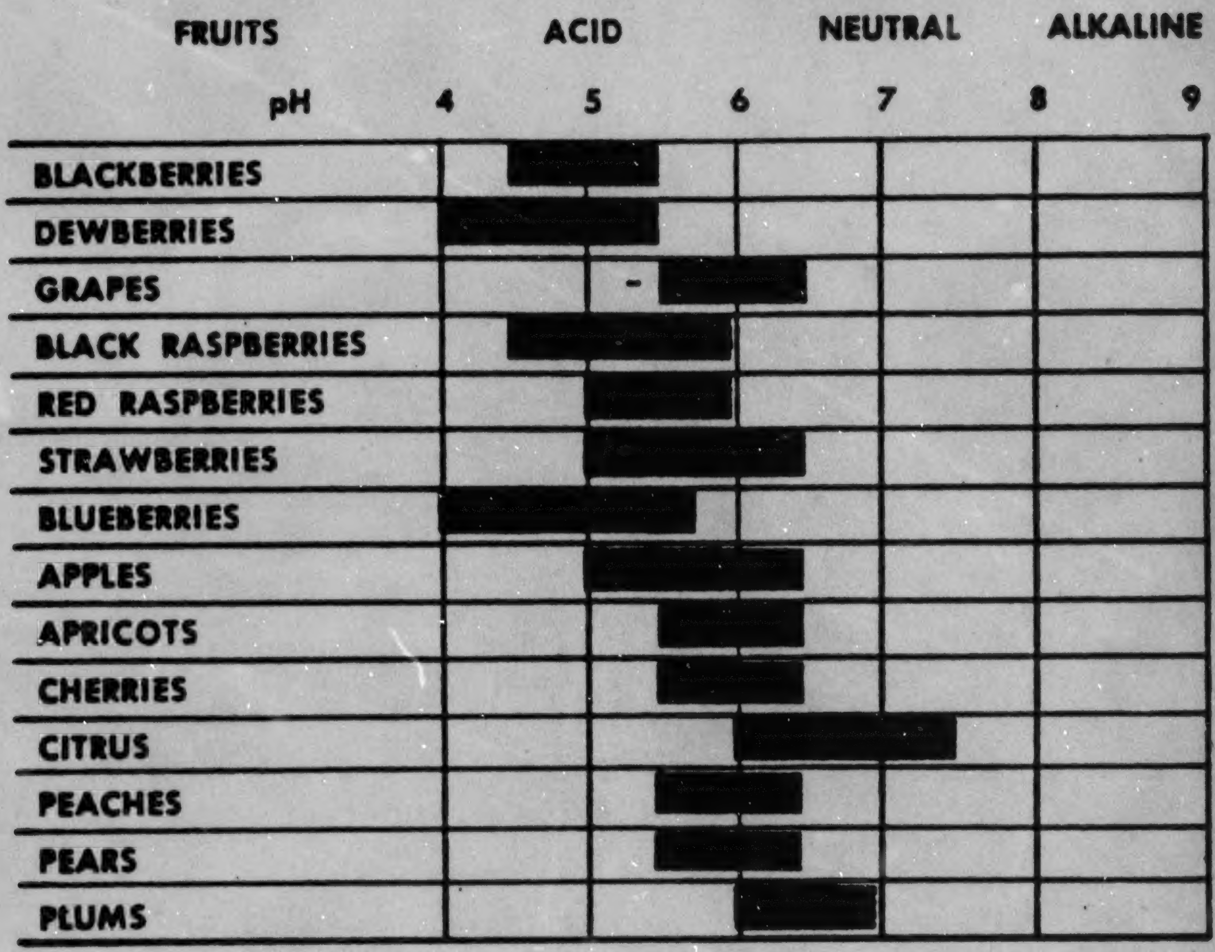
Best soil pH range for various shrubs



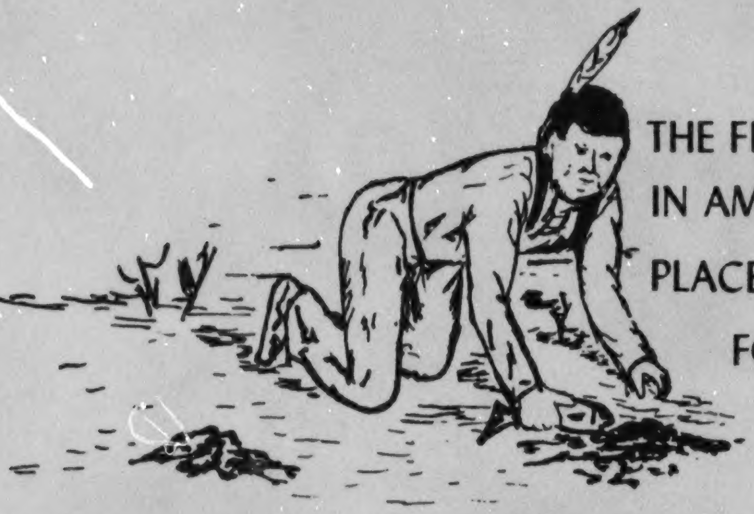
Best soil pH range for various trees



Best soil pH range for various fruits

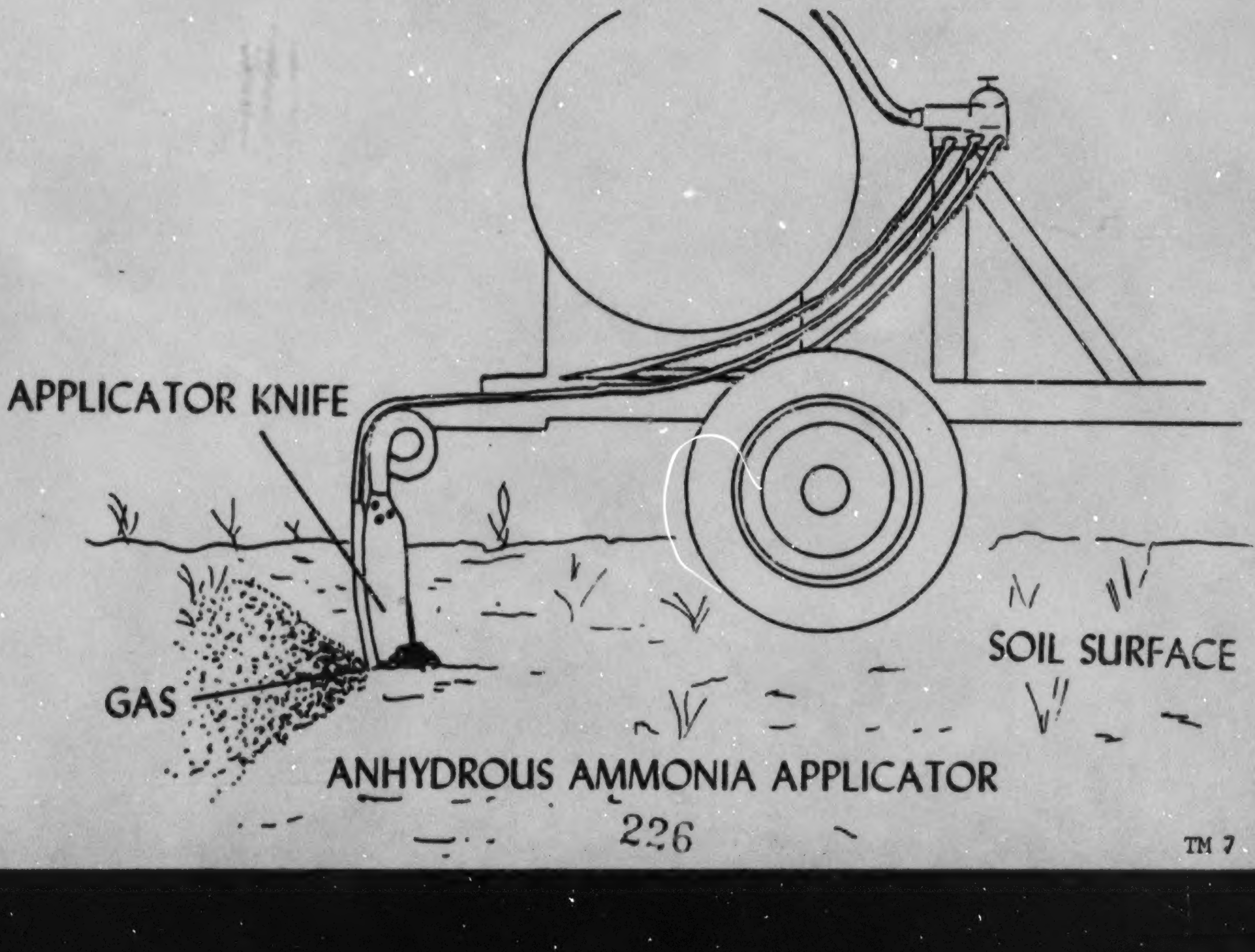


AN EARLY METHOD OF APPLYING FERTILIZER IN AMERICA



THE FIRST USE OF FERTILIZER IN AMERICA, A FISH WAS PLACED IN THE HILL FOR CORN

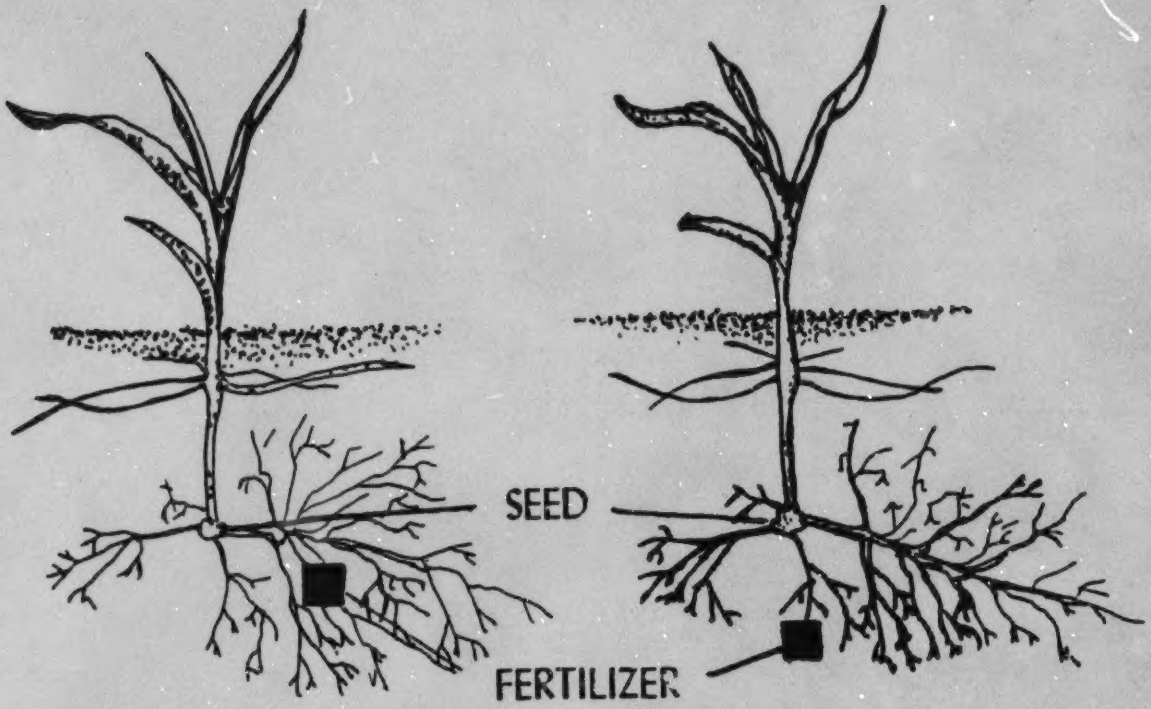
ONE OF THE MODERN METHODS USED TO APPLY FERTILIZER


APPLICATOR KNIFE
GAS
SOIL SURFACE

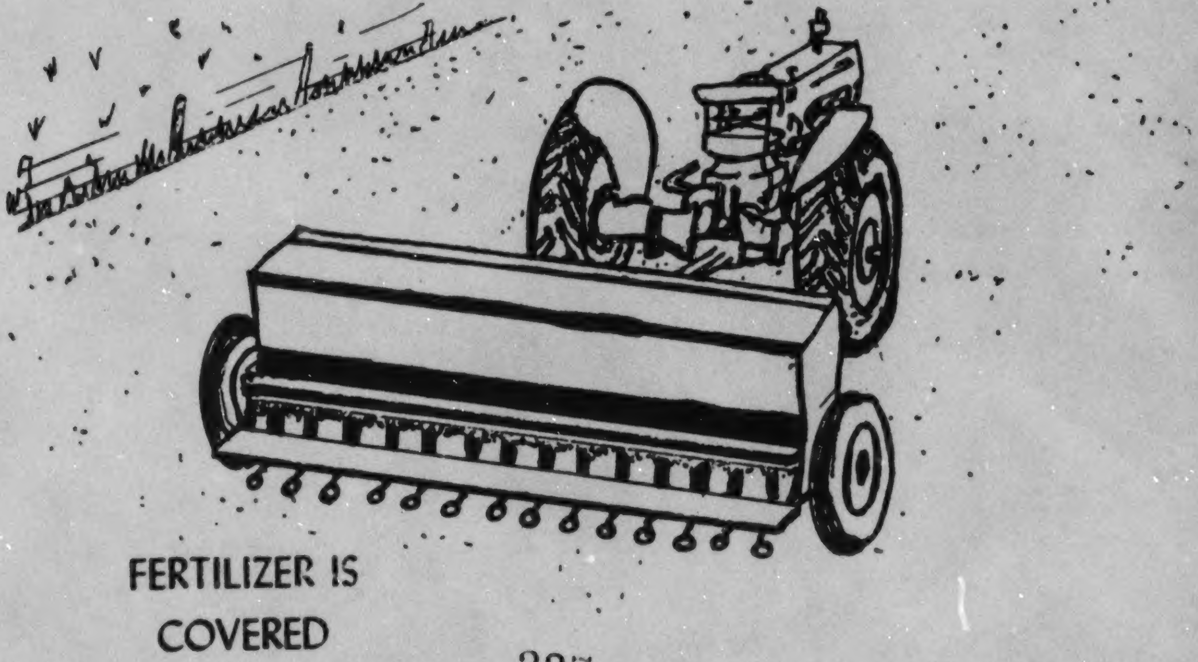
ANHYDROUS AMMONIA APPLICATOR

APPLICATION OF FERTILIZER

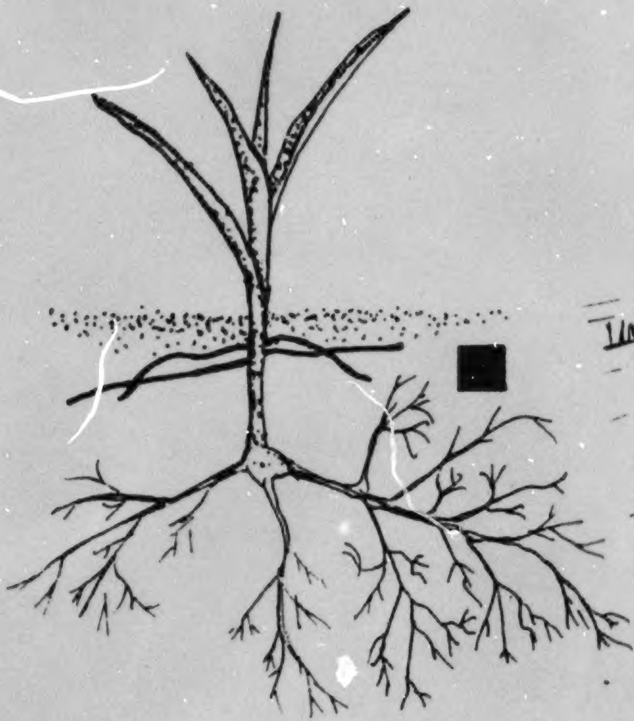
BAND OF FERTILIZER


SEED
FERTILIZER

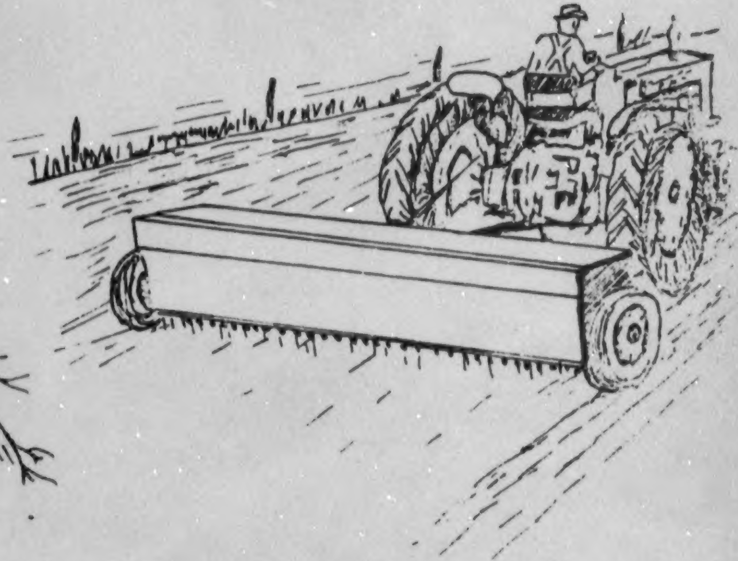
TOP-DRESSING FERTILIZER


FERTILIZER IS COVERED

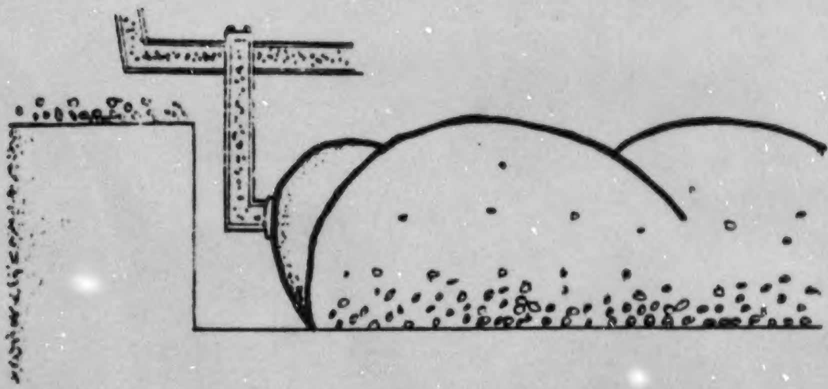
APPLICATION OF FERTILIZER



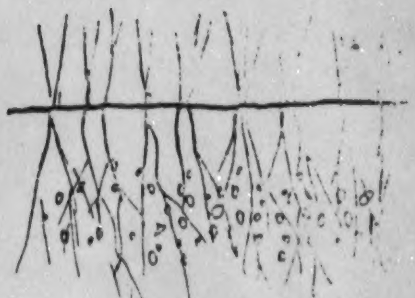
SIDE-DRESSING FERTILIZER



BROADCASTING

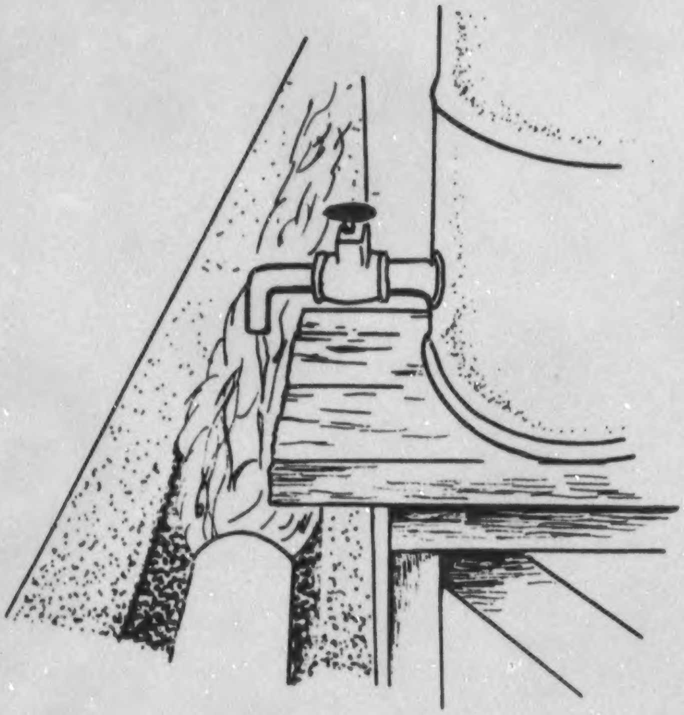


PHOSPHOROUS PLOWED
INTO TOPSOIL

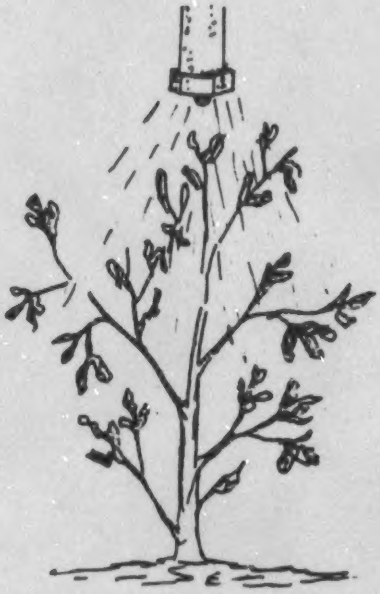


PHOSPHOROUS
AVAILABLE TO
ROOT SYSTEM

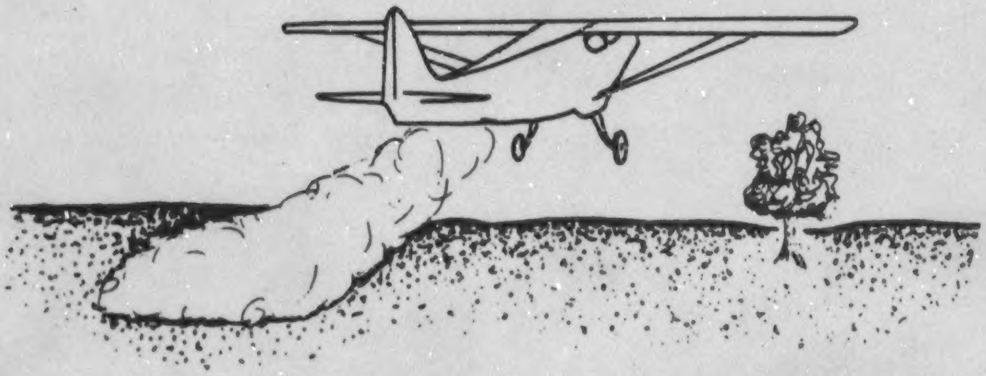
APPLICATION OF FERTILIZER



APPLYING FERTILIZER TO IRRIGATION WATER

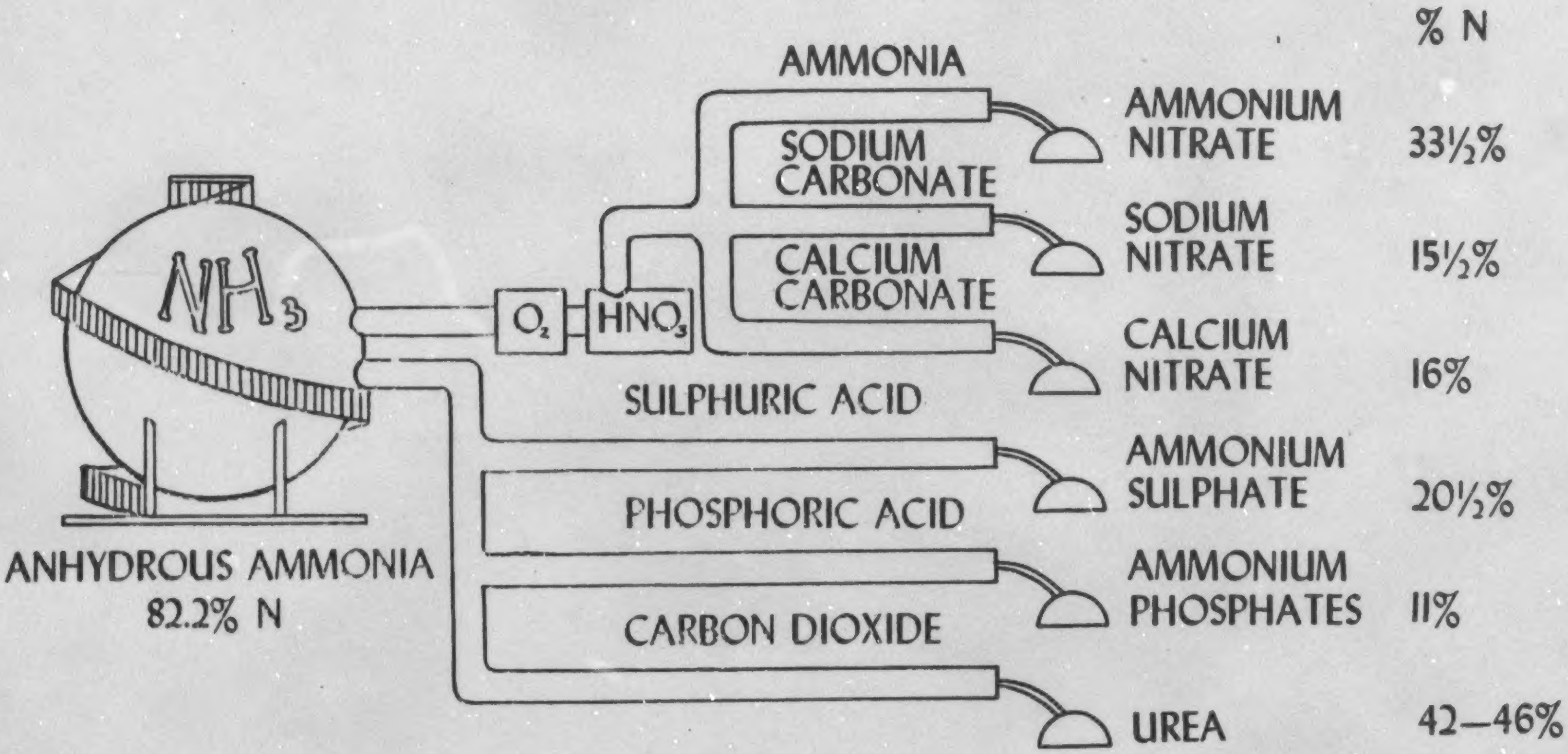


FOILAGE SPRAYING



APPLYING FERTILIZER BY AIRPLANE

NITROGEN FERTILIZER PRODUCTION



NH_3
O_2
HNO_3
AMMONIA
SODIUM CARBONATE
CALCIUM CARBONATE
SULPHURIC ACID
PHOSPHORIC ACID
CARBON DIOXIDE

ANHYDROUS AMMONIA
82.2% N

	% N
AMMONIUM NITRATE	33½%
SODIUM NITRATE	15½%
CALCIUM NITRATE	16%
AMMONIUM SULPHATE	20½%
AMMONIUM PHOSPHATES	11%
UREA	42–46%

HORTII SE U1-27

TM11

FERTILIZERS

UNIT 1

ASSIGNMENT SHEET #1: Calculate Cost Per Pound of Nitrogen for Different Fertilizer Analysis.

Compare the cost per pound of actual nitrogen for each fertilizer. When you have completed the problems, turn in to your instructor for evaluation. Ask instructor for the local price per ton of each analysis.

1. Ammonium nitrate 33.0% Local price per ton ___________

2. Anhydrous ammonia 82.0% Local price per ton ___________

3. Urea 45.0% Local price per ton ___________

FERTILIZERS

UNIT 1

ASIGNMENT SHEET #2: Calculate Application Rates of Fertilizers.

Calculate the amount of nutrients needed using the different fertilizer analysis. When completed return to instructor for his evaluation.

1. A farmer desires to plant wheat with a 0-20-0 analysis at a rate of 100 lbs. per acre. How many pounds of fertilizer would be needed?

2. How many pounds of 0-0-60 would be needed to apply 40 lbs. of K_2O per acre?

3. How many pounds of 82-0-0 would be needed to apply 100 lbs. of N per acre?

ASSIGNMENT Sheet #3. Make fertilizer Recommendations using the soil test information given and the Fertilizer Recommendation Guides, recommend the amount of fertilizer needed for each sample. Also make recommendations concerning the amount of lime to use to the pH of the soil.

I. Compute the following tests for the Central Region, maximum yield, dryland, and continuous cropping.

REPORT OF SOIL FERTILITY TESTS

Name: ____________________

Address: ____________________
(Street or Route)
____
(City and State) Zip

County: ____________________

Name: ____________________

Address: ____________________
(Street or Route)
____
(City and State) Zip

Date Rec'd: ____________________

Date Reported: ____________________

Legal Description: ____¼; ____¼; ____¼; Sec. ____; T____; R____

Analyst: ____________________

IDENTIFICATION		SOIL TEST RESULTS									
							DTPA				
Laboratory Number	Field and Sample No.	Soil pH	Effective Calcium Carbonate (E.C.C.) lbs. E.C.C./Acre	Available Phosphorus lbs p/Acre	Exchangeable Potassium lbs. K. Acre	Organic Matter %	Available Zinc ppm Zn.	Available Iron ppm Fe	Sample Depth i.e. 0-6" 6-24"	Available Nitrogen ppm N.	Available Profile Nitrogen ppm N.

IDENTIFICATION			FERTILIZER AND LIME RECOMMENDATIONS						COMMENTS
			Lime*	POUNDS NUTRIENTS RECOMMENDED				Other	
Field and Sample No.	Year	Intended Crop	lbs E.C.C./A	Nitrogen lbs/A	Phosphate lbs/A	Potash lbs/A	Zinc lbs/A		Time and Method of Application

FERTILIZERS

UNIT 1

ASSIGNMENT SHEET #4: Calculate Rate of Agriculture Lime.

Calculate the amount of lime needed using the different lime requirements and liming materials when completed return to instructor for his evaluation.

1. A farmer desires to increase his soil pH for maximum plant growth. His soil test result shows that 4000 lbs. of ECC/A will be needed to raise the soil pH to the desired level. The local dealer will guarantee Ag lime with 50 percent ECC. How much Ag lime will the farmer have to apply per acre to meet the recommended application.

FERTILIZERS

UNIT 1

JOB SHEET #1: Interpreting Soils Test Recommendations for Nitrogen.

A. Multiply available profile nitrogen PPM N. x 8 million lbs. of soil at a depth of 24" per acre.

Example: Soil test reads 25.0 PPM profile nitrogen.

25.0	PPM Nitrogen
x 8	Million lbs. in acre to depth of 24 inches
200.0	pounds of available nitrogen per acre

FERTILIZERS

UNIT 1

TEST

1. Match the terms on the left to the correct definitions.

_____a. A term used to indicate the degree of acidity or alkalinity of the soil.

_____b. A mixture of two carriers.

_____c. The quantity and grade of materials used in making fertilizer mixture.

_____d. A term used to refer to soils containing 20% or more organic matter.

_____e. The material added for weight to the fertilizer which does not contain N, P_2O_5, or K.

_____f. Any natural manufactured or processed material or mixture of materials that contains one or more of the recognized plant food elements, either liquid or dry.

_____g. The soil having a basic reaction; the pH is above 7.0

_____h. The ratio of nitrogen, phosphate, and potash in a fertilizer

_____i. The soil that contains enough exchangeable sodium to adversely affect the growth of most crops.

_____j. The total of the fertilizer analysis.

_____k. The soil having an acid reaction; the pH is below 7.0.

_____l. The percent of content of total (N) nitrogen available (P) phosphorus expressed as P_2O_5 and the amount of water soluble (K) potassium expressed as K_2O.

_____m. The material added to the fertilizer in order to improve its physical condition.

_____n. The trademark of the company which produced the fertilizer.

1. Acid soil
2. Alkali soil
3. Conditioner
4. Formula
5. pH
6. Fertilizer
7. Alkaline soil
8. Ratio
9. Organic soil
10. Grade
11. Yield possibility
12. Analysis
13. Complete fertilizer
14. Mixed fertilizer
15. Percent sufficiency
16. Filler
17. Brand
18. Carrier

TEST

_____o. The material added to the fertilizer which does not contain N, P_2O_5, or K.

_____p. The yield obtained for a given cropping situation when all nutrients are adequate.

_____q. A fertilizer containing only one nutrient.

_____r. The percent of the yield possibility obtained because of the deficiency of a plant nutrient.

_____s. One which supplies all three of the major nutrients.

2. Name five factors that influence the use of fertilizers.

3. List the sixteen elements known to be essential for plant growth and name the correct chemical symbol for each.

4. Name the three major (primary) plant nutrients and name three characteristics of each.

5. Name three minor (secondary) plant nutrients and name three characteristics of each.

6. Name three micro-elements necessary for plant growth which are usually found in sufficient quantity in most soils.

7. Name the four requirements that must be stamped on fertilizer bags according to state law.

8. Classify the following fertilizers according to ordinary, high analysis, or concentrated.

   a. 10-20-10

   b. 5-10-0

   c. 82-0-0

   d. 16-20-0

TEST

9. Define the following.

   a. Dry mixed fertilizer -

   b. Liquid fertilizer -

   c. Gas fertilizer -

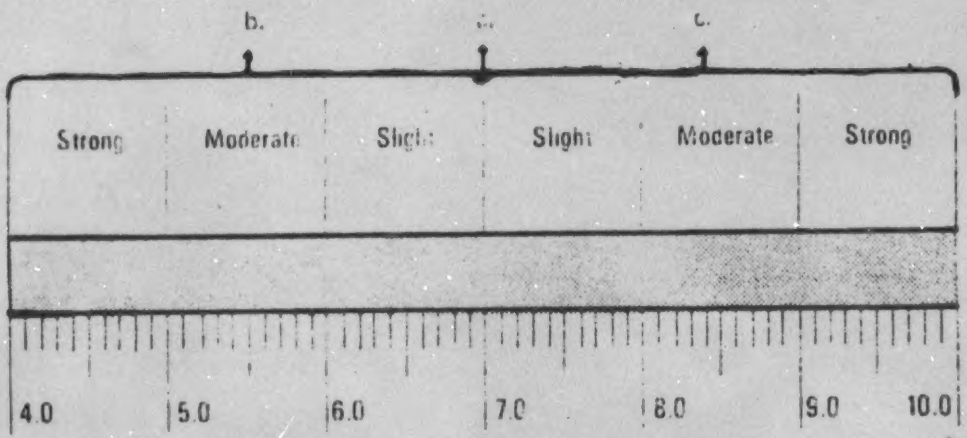
10. Discuss in a short paragraph what 20-10-10 means according to fertilizer analysis.

11. Match the descriptions of hunger signs of plants on the right to examples of their food.

_____a. Phosphorus
_____b. Nitrogen
_____c. Magnesium
_____d. Potassium

1. Plants stunted and spindly, yellowish-green foliage, older leaves affected first, and leaf margins remain green.
2. Stunted growth, abnormally green appearance leaves become purple in advanced stages and older leaves are affected first.
3. Plants show general yellowing, older leaves affected first, leaves become reddish-purple in advanced stages, veins remain green, and leaves may curl downward.
4. Short plants, general loss of green color and leaf margins affected first.

12. Identify the following parts of the pH scale. Use the information given below and the scale and determine if the soil is acid or alkaline.



a. ____

b. ____

c. ____

TEST

Suppose you were growing the following crops and soil test information was available on each field. Using the pH scale given, determine if the soil is acid, neutral, or alkaline.

d. Alfalfa soil test 5.5_____________________________________

e. Corn soil test 7.2_____________________________________

f. Wheat soil test 7.0_____________________________________

g. Sorghum soil test 8.2_____________________________________

13. Name three ways liming benefits plant growth.

14. Match the plants on the right to the most desirable pH scale range.

_____a. Oats
_____b. Corn
_____c. Alfalfa
_____d. Watermelons
_____e. Sudangrass
_____f. Cotton
_____g. Sorghum

1. Strong acidity 5.0 to 5.5
2. Medium to moderate acid 5.5 - 6.5
3. Slightly acid to slightly alkaline 6.5 to 7.5

15. Classify the following fertilizers according to their percent nutrient value from the highest percent to the lowest. Place the percent in the blank provided.

a. Nitrogen

_____Ammonia sulfate
_____Anhydrous ammonia
_____Urea
_____Ammonia nitrate

b. Phosphate

_____Phosphoric acid
_____Rock Phosphate
_____Nitric phosphate
_____Cons. superphosphate
_____Ammonium phosphate

c. Potash

_____Potassium sulfate
_____Potassium nitrate
_____Muriate of potash

TEST

16. Name four factors to consider in caring for fertilizer equipment.

17. Name three factors to consider in storing fertilizers.

18. Work the following nitrogen problems.

    a. Suppose you were using ammonium nitrage which is 33.0 percent nitrogen and cost $68.00 per ton. What would it cost you per pound?

    b. Suppose you were using anhydrous ammonia which is 82.0 percent nitrogen and cost $85.00 per ton. What would it cost you per pound?

19. Work the following lime problem.

    A. Suppose your soil test recommended 8,000 lbs. of ECC per acre lime and Ag lime available test 8%. What would be the application rate per acre of the Ag lime?

FERTILIZERS

UNIT 2

ORGANIC FERTILIZERS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to organic fertilizers; identify sources of organic matter the initial chemical reaction and effects of soil temperature, aeration, moisture, and soil reaction on the rate of decomposition of organic matter. The students will also be able to describe the nature and value of humus, the C:N cycle, the production of organic matter, and the sources of organic fertilizers. This objective will be considered achieved upon successful performance of the job assigned and attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms and definitions pertaining to organic fertilizers.
2. List three sources of soil organic matter.
3. Name four factors that affect the rate of decomposition of organic matter.
4. Select from given statements those that describe the effects of soil temperature on the rate of decomposition of organic matter.
5. Select from given statements those that describe the effects of soil aeration and moisture on the rate of decomposition of organic matter.
6. Complete a given incomplete sentence so that it accurately describes an effect of soil reaction on the rate of decomposition of organic matter.
7. List the effects of the initial chemical composition of organic matter on green manure and crop residues.
8. Select statements that are true and false about the value and anture of humus.
9. State the C:N ratio of organic matter in the final stage of decomposition.
10. Name two organic matter production methods.
11. List at least five functions of crop growing to produce organic matter.
12. Name two kinds of manures that can be produced.
13. Name two other sources of organic fertilizers.
14. Construct a compost pile.

FERTILIZERS

UNIT 2

INFORMATION SHEET

I. Terms and Definitions

A. Green manure - Soil-improving crop grown primarily to add organic matter.

B. Cover crops - Soil-improving crop grown primarily to serve as a ground cover .

C. Humus - The dark brown substance, resulting from decomposition containing organic matter, that gives color and other properties to soil .

D. Cation exchange - The chemical process whereby plants absorb minerals from the soil .

E. Artificial manure (synthetic) - Consists of the decomposition of organic matter under more or less controlled conditions .

F. Compost - Is a mixture of soil and partly decayed organic matter or humus .

G. Lignin - An organic substance which, with cellulose, forms the chief part of woody tissue (40% to 45% of total humus) .

H. Lignocellulose - The substance making up the woody and fibrous parts of a plant, consisting of lignin combined with cellulose .

I. Peat - A brown, spongy, semigranular material which is dry and easy to handle .

II. Soil Organic Matter Comes From

A. Dead plants

B. Animal remains

C. Dead soil organisms

III. Soil Condition Factors that Affect the Rate of Decomposition of Organic Matter

A. Soil temperature

B. Soil aeration and moisture

C. Soil reaction

D. Initial chemical composition of organic matter

IV. Effects of Soil Temperature on the Rate of Decomposition of Organic Matter

A. The rate of decomposition of organic matter is at least twice as rapid at 86°F. as at 68°F., and twice as rapid at 68°F. as at 50°F .

INFORMATION SHEET

B. Apply organic matter more often in warm climates than in cool climates. (See Unit 4)

V. Effects of Soil Aeration and Moisture on the Rate of Decomposition of Organic Matter

A. Decomposition of organic matter in soils requires free oxygen and water.

B. Saturated soils have inadequate quantities of oxygen - decomposition is low.

C. Dry soils have inadequate quantities of water - decomposition is low .

D. Moist soils have optimum quantities of both oxygen and water - decomposition takes place at its most rapid rate .

VI. Effects of Soil Reaction on the Rate of Decomposition of Organic Matter

A. This refers to the degree of acidity in the soil .

B. The degree of acidity of the soil solution influences the growth and activity of soil organisms.

C. Decomposition rate is most rapid in moderately acid or slightly acid soil.

VII. Initial Chemical Composition of Organic Matter

A. Green manure crops

1. Early stages of growth contain large quantities of sugars, starches, and simple proteins - decompose rapidly.

2. Mature stage of growth contains low quantities of sugars but large quantities of cellulose - decompose slowly.

B. Crop residues, raw straw, stubble, sawdust, is made up of lignocellulose and lignin compounds that decompose slowly.

VIII. Nature and Value of Humus

A. Humus is important in the cation exchange

B. Humus is important in phosphate availability

C. Humus is important in reducing aluminum toxicity in the soil

D. Humus is important in water-holding capacity and soil aeration

IX. The Carbon:Nitrogen Ratio (C:N) of Organic Matter (See TM 1)

A. When organic matter is incorporated with soil, its ratio of carbon to nitrogen is usually quite wide. (Example 80:1)

INFORMATION SHEET

B. As decomposition proceeds, large amounts of carbon dioxide are released until a ratio of 10:1 is achieved.

C. After 10:1 ratio has been attained, further decomposition results stay in the same ratio.

D. Therefore, organic matter in its final state of decomposition has a ratio of 10 parts of carbon to 1 part of nitrogen *.

(NOTE: *Some authorities state a ratio of C:N is 12:1)

X. Organic Matter Production Methods

A. Growing of crops

B. Production of manure

XI. Functions of Crop growing (Soil-improving crops) to Produce Organic Matter

A. To provide a cover for the soil

B. To add organic matter

C. To conserve supplies of certain essential elements

D. To retard erosion

E. To check vegetative growth of crop plants

F. To retain snow in cold climates - keeps roots and soil warmer

XII. Production of Manure to Produce Organic Matter

A. Animal manure

1. Consists of a mass of organic compounds in various states of decomposition.
2. Some of these compounds decompose slowly; others quickly.
3. Finally changes to humus.
4. Disadvantage - Takes huge quantities of manure to equal a very small amount of commercial fertilizer. (Example: A ton of horse manure average composition contains about 10 pounds of nitrogen, 5 pounds of phosphoric acid, and 10 pounds of potash. This has an analysis of 0.5% nitrogen, 0.25% phosphoric acid, and 0.5% potash. Moreover, only about ½ of the potash is immediately available to plants.)

NOTE: Many experiments with vegetable crops have shown that applications of moderate amounts of manure (10 to 15 tons per acre), combined with the use of commerical fertilizers (500 to 1000 pounds per acre) have produced greater yields than the use of heavy applications of manure alone (20 to 40 tons per acre).

INFORMATION SHEET

B. Artificial Manure

1. Various types of organic matter may be used; e.g., straw, hay, cornstalks, weeds, lawn clippings, and leaves.
2. Organic matter is treated layer by layer with commercial fertilizer and lime, and may or may not be wetted down by artificial applications of water.
3. Water supply is the most important factor for breaking down the artificial manure for plant use.

XIII. Other Sources of Organic Fertilizers

A. Peat

1. Free from disease pests
2. High water-holding capacity (15-1)

B. Compost (See Job Sheet)

1. Mixture of soil and partly decayed organic matter (any type).
2. Properly prepared compost is free of weeds and odor.
3. Rich in plant nutrients.

Organic Matter of Various C:N Ratios

Organic matter low in C, high in N (a very narrow ratio)	Organic matter high in C, High in N (a narrow ratio)	Organic matter high in C, low in N (a wide ratio)	Organic matter very high in C, low in N (a very wide ratio)
Liquid manure (10:1) Legumes in early stages of growth (15:1-20:1)	Legumes in late stages of growth (20:1) Nonlegumes in early stages of growth (20:1)	Rotted straw and rotted leaves (60:1) Nonlegumes in late stages of growth (60:1)	Straw (80:1) Stubble (80:1) Strawy manure (80:1) Leaves (80:1) Sawdust (400:1) Paper (680:1)

Major Natural Sources of One Element

MAJOR NATURAL SOURCES OF NITROGEN			
MATERIAL	NITROGEN %	APPLY PER 100 SQ. FT.	APPLY PER ACRE
Bloodmeal	15.0	10 oz.	265 lbs.
Felt wastes	14.0	12 oz.	285 lbs.
Hoofmeal & Horndust	12.5	13 oz.	320 lbs.
Guano	12.0	14 oz.	335 lbs.
Animal Tankage	8.0	1-1/4 lbs.	500 lbs.
Cottonseed Meal	8.0	1-1/4 lbs.	500 lbs.
Fish Scrap	8.0	1-1/4 lbs.	500 lbs.
Milogranite (activated sludge)	6.0	1-5/8 lbs.	665 lbs.
Castor Pomace	5.5	1-3/4 lbs.	725 lbs.
Bone Meal	4.0	2-1/2 lbs.	1000 lbs.
Peanut Shells	3.6	2-3/4 lbs.	1100 lbs.
Tobacco Stems or Powder	3.3	3 lbs.	1200 lbs.
Cowpea, Vetch, or Alfafa Hay	3.0	3-5/8 lbs.	1450 lbs.
Cocoa Shells	2.7	3-3/4 lbs.	1500 lbs.

MAJOR NATURAL SOURCES OF POTASH			
MATERIAL	POTASH %	APPLY PER 100 SQ. FT.	APPLY PER ACRE
Flyash	12	14 oz.	335 lbs.
Wood Ashes	8	1-1/4 lbs.	500 lbs.
Granite Dust	5	2 lbs.	800 lbs.
Seaweed	5	2 lbs.	800 lbs.
Fish Scrap, Dried	4	2-1/2 lbs.	1000 lbs.
Greensand	7	1-1/2 lbs.	570 lbs.
Tobacco Stems (Powder)	7	1-1/2 lbs.	570 lbs.

MAJOR NATURAL SOURCES OF PHOSPHORUS			
MATERIAL	PHOSPHORUS %	APPLY PER 100 SQ. FT.	APPLY PER ACRE
Phosphate Rock	30.0	3/4 lb.	270 lbs.
Bone Meal, Steamed	28.0	3/4 lb.	280 lbs.
Bone Meal, Raw	24.0	7/8 lb.	330 lbs.
Animal Tankage	20.0	1 lb.	400 lbs.
Fish Scrap, Dried	13.0	1-3/4 lbs.	675 lbs.
Basic Slag	8.0	2-1/2 lbs.	1/2 ton
Sugar Wastes, Raw	8.0	2-1/2 lbs.	1/2 ton
Incinerator Ash	5.0	4 lbs.	3/4 ton
Cottonseed Meal	2.5	8 lbs.	1-1/2 tons

Natural Plant Food Sources, More than One Element

MATERIAL (Contains %)	NITROGEN	PHOSPHORUS	POTASH
Activated Sludge	6.0	3.0	–
Animal Tankage	8.0	20.0	–
Alfafa Hay	2.5	0.5	2.0
Bloodmeal	15.0	1.0	0.5
Bone Meal	4.0	24.0	–
Horse, Cattle Manure – Fresh	0.3	–	0.3
Castor Pomace	5.5	1.5	1.0
Cocoa Shells	2.7	1.5	2.7
Coffee Grounds (Dried)	2.0	0.3	0.5
Cottonseed Meal	8.0	2.5	1.5
Fish Scrap	8.0	13.0	4.0
Greensand	–	1.5	7.0
Guano	12.0	8.0	3.0
Hen Manure – Fresh	1.6	1.5	1.0
Hoofmeal & Horndust	12.5	1.5	–
Incinerator Ash	0.2	5.0	2.0
Seaweed	1.5	1.0	5.0
Sheep Manure – Fresh	0.5	0.3	–
Tobacco Stems, Powder	3.3	–	7.0
Wood Ashes	–	1.5	8.0

TM 3

FERTILIZERS

UNIT 2

ASSIGNMENT SHEET #1: Dissolving Rate and Solubility of Fertilizers

I. Do the following:

   A. Place samples of fertilizer in jars of water and observe the rate of dissolving and solubility.

FERTILIZERS

UNIT 2

JOB SHEET #1: Construct a Compost Pile.

I. Materials Needed:

A. Variety of organic material (leaves, grass clippings, sawdust, garbage).

B. A spade.

C. A pitch fork.

D. A patch of ground.

E. Soil.

II. Procedure:

A. Dig a pit minimum size 3 x 3 x 3 feet, (or construct a box above ground)

B. Make layers of organic material and soil.

C. Water thoroughly.

D. For faster decomposition cover mixture.

E. Turn the pile and water as needed (keep moist). Tamp lightly when watering.

F. Add organic materials as accumulated.

G. Earthworms may be added.

H. Use when desired texture is reached.

III. Special Notes:

A. Many growers prefer to keep two piles for composting, one under construction and the other ready for use.

B. Decomposition organisms are active over a wide temperature range, 40°F. to 170°F. At the extremes, decomposition is low. 70°F. to 90°F is best.

C. To hasten decomposition, heat-generating materials, (like grass clippings or organic fertilizers) with a high nitrogen content can be added.

D. Discuss the commercially prepared microorganism sources for inoculating compost pile with the instructor.

E. Compost that has been produced over a short period of time tends to have a neutral pH of 7.0. The longer it stands, the more acid it becomes. If too acid, add some lime.

FERTILIZERS

UNIT 2

TEST

1. Match the correct word to its definition

___a. Peat

___b. Lignin

___c. Compost

___d. Lignocellulose

___e. Cation exchange

___f. Green manure

___g. Cover crops

___h. Humus

___i. Artificial manure

1. Soil-improving crops grown primarily as ground cover.
2. The chemical process whereby plants absorb minerals from the soil
3. Consists of the decomposition of organic matter under more or less controlled conditions.
4. The substance making up the woody and fibrous parts of a plant, consisting of lignin combined with cellulose.
5. Soil-improving crop grown primarily to add organic matter.
6. A brown, spongy, semigranular material which is dry and easy to handle.
7. A mixture of soil and partly decayed organic matter.
8. An organic substance which, with cellulose, forms the chief part of woody tissue.
9. The dark, brown substance, resulting from decomposition containing organic matter, that gives color and other properties to soil.

2. List three sources of organic matter.

a.

b.

c.

3. List four factors which affect the rate of decomposition of organic matter.

a.

b.

c.

d.

TEST

4. Select from the given statements those that describe the effects of soil temperature on the rate of decomposition of organic matter

   a. As soil temperature increases, the decomposition of organic matter decreases.

   b. The rate of decomposition or organic matter is at least twice as rapid at 86°F as at 68°F.

   c. Increase the application amounts or organic matter as the soil temperature decreases.

   d. The rate of decomposition is twice as rapid at 68°F as at 50°F.

   e. The rate of decomposition of organic matter doubles with each 10 degree rise in soil temperature.

   f. Apply organic matter more often in warm climate than in cool climates.

5. Select from given statements those that describe the effects of soil temperature on the rate of decomposition of organic matter by circling the correct statements.

   a. Saturated soils have adequate quantities of oxygen.

   b. Decomposition of organic matter in soils requires free oxygen and water.

   c. Dry soils have inadequate quantities of water - decomposition is low.

   d. High temperatures slow the decomposition of organic matter.

   e. Low temperatures accelerate the decomposition of organic matter.

   f. Moist soils have optimum quantities of both oxygen and water - decomposition takes place at its most rapid rate.

6. Fill in the blanks to correctly complete the following statement:

   The rate of organic matter __________ __________ in slightly

   __________ soils.

7. Write brief statements c ncerning the decomposition of organic matter for:

   a. Green manure

   b. Crop residues

TEST

8. Please circle T for true and F for false for each of the following statements about the nature and value of humus.

   T F a. Humus is important in the cation exchange.

   T F b. Humus is important in phosphate availability.

   T F c. Humus increases aluminum toxicity in soils.

   T F d. Humus is important in water-holding capacity and soil aeration.

   T F e. Humus decreases the water-holding capacity of soils.

9. When organic matter is incorporated with the soil, decomposition continues until there is a final ratio of ____________ parts of carbon to ___________ parts of nitrogen.

10. List two ways in which organic matter can be produced.

    a.

    b.

11. Give four functions of crop-growing (soil-improving crops) for producing organic matter.

12. List two sources of manure.

13. Name two sources of organic fertilizer.

14. Complete Job Sheet #1 to the satisfaction of the instructor.

FERTILIZERS

UNIT 3

INORGANIC FERTILIZERS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to inorganic fertilizer; to list the primary, secondary, and trace elements necessary for plant growth; and to describe the roles all elements play in plant growth, the factors that determine inorganic fertilizer selection, and the principal features of modern inorganic fertilizers. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that pertain to inorganic fertilizers.
2. List three primary elements, three secondary elements, and seven trace elements in inorganic fertilizer.
3. Select from given phrases those which apply to the roles that nitrogen, phosphorous, and potassium play in plant growth.
4. Select from given phrases those which apply to the roles that calcium, magnesium, and sulfur play in plant growth.
5. Select from given phrases those which apply to the roles that boron, iron, copper, zinc, manganese, and moylbdenum play in plant growth.
6. List six factors that determine inorganic fertilizer selection.
7. Identify as true or false given statements concerning the features of modern inorganic fertilizers.

FERTILIZERS

UNIT 3

INFORMATION SHEET

I. Terms and Definitions

A. Micro-nutrients - Trace elements (minor plant foods).

B. Fertilizer - Any material which supplies any essential plant food in an available form.

C. Commercial Fertilizer - Fertilizer sold commercially containing mostly nitrogen, phosphorus, and potassium (N, P, and K) in varying proportions, and occasionally other nutrients.

D. Mixed Fertilizer - Contains two or more of the nutrients.

E. Complete Fertilizers - Contains all three primary nutrients, N, P, and K.

F. Analysis - An expression of its composition. All states require fertilizer manufacturers to print a guaranteed analysis or chemical composition on the fertilizer bag and/or attached tag. Gives total N,P,K.

G. Translocation - The movement or conduction of water soluble organic materials and minerals from one part of the plant to another part.

H. Respiration - The controlled breaking down or burning of glucose manufactured through photosynthesis to produce energy for plant processes.

I. Chemical Fertilizers - Are synthesized from inorganic minerals.

J. Ratio - The proportion of the primary elements, N, P, K: 10-20-10 is 1-2-1.

K. Incomplete Fertilizer - When one or two of the primary elements is missing: 0-0-10 or 10-0-0.

II. Fertilizer Nutrients

A. Primary Elements

1. Nitrogen (N)
2. Phosphorus (P)
3. Potassium (potash) (K)

B. Secondary Elements.

1. Calcium (Ca)
2. Magnesium (Mg)
3. Sulfur (S)

INFORMATION SHEET

C. Trace Elements (micro-nutrients)
   1. Iron (Fe)
   2. Copper (Cu)
   3. Zinc (Zn)
   4. Boron (B)
   5. Chlorine (Cl)
   6. Manganese (Mn)
   7. Molybdenum (Mo)

III. The Effects of Primary Elements

A. The role nitrogen plays in plant growth
   1. Produces a healthy green color
   2. Induces rapid growth
   3. Increases protein content of plant in absolute amounts
   4. Necessary for chlorophyll manufacture
   5. Deficiency symptoms:
      a. Sickly yellow-green color.
      b. A distinct slow and dwarfed growth
      c. Drying up or firing of leaves which starts at the bottom of the plant and proceeds upward. The firing starts at the top of the bottom leaves and proceeds down the center along the mid-rib.

NOTE: An over-abundance of nitrogen leads to rank vegetative growth and tends to retard the date of plant maturity. It also contributes to danger of too high soluble content of soil solution causing root injury and stunted plants.

B. The role phosphorus plays in plant growth
   1. Stimulates easy root formation and growth
   2. Gives a rapid and vigorous start to plants
   3. Hastens maturity.
   4. Stimulates blooming
   5. Appears in the transformation of insoluble carbohydrates to soluble carbohydrates
   6. Deficiency symptoms:
      a. Slow growth and maturity
      b. Purplish leaves, stems, and branches

INFORMATION SHEET

C. The role potassium plays in plant growth
  1. Imparts increased vigor and disease resistance to plants.
  2. Essential to the formation and transfer of starches, sugars, and oils.
  3. Deficiency symptoms
    a. Mottling, spotting, streaking, or curling of leaves.
    b. Leaves become scorched, or burned on the margins or tips.
    c. Firing starts at tip of leaf and proceeds downward.

IV. The Effects of Secondary Elements
  A. The role calcium plays in plant growth.
    1. Promotes early root formation and growth.
    2. Improves general plant vigor.
    3. Influences the intake of other plant nutrients.
    4. Deficiency symptoms:
      a. Young leaves in terminal bud become hooked in appearance and then die at the tips and along the margin.
      b. Roots are short and much-branched
      c. Leaves have a wrinkled appearance
      d. Plants could exhibit deficiency symptoms of other nutrients, since the proper balance of calcium influences intake of other nutrients.
  B. The role magnesium plays in plant growth
    1. Essential to the formation of fats
    2. Aids in the transport of phosphorus
    3. Influences uptake of other plant nutrients
    4. Aids in translocation of starch
    5. Deficiency symptoms
      a. Loss of green color starting in the bottom leaves and later moves up the stalk - the veins of the leaf remain green.
      b. The plant stem is slender and weak
      c. Leaves are mottled
      d. Leaf tips are turned or cupped upward
  C. The role sulfur plays in plant growth
    1. Promotes root growth
    2. Essential to the formation of some proteins
    3. Encourages more vigorous growth

INFORMATION SHEET

4. Deficiency symptoms
    a. The young leaves are light green in color and have even lighter veins.
    b. The stalks are short and slender.
    c. Plant growth is slow and stunted.

V. The Effects of Trace Elements (Micro-nutrients)
  A. The role boron plays in plant growth
    1. Influences water absorption
    2. Aids in translocation of sugar
    3. Deficiency symptoms
        a. Young leaves of terminal buds become light green at the base.
        b. In later growth the leaves become twisted and the stalk finally dries back to the terminal bud.

  B. The role iron plays in plant growth
    1. Essential to chlorophyll production.
    2. Acts as an electron carrier in enzyme systems which bring about oxidation.
    3. Deficiency symptoms
        a. The young leaves are mottled with the principal veins remaining green.
        b. The stalks are short and slender.
  C. The role copper plays in plant growth
    1. Acts as an electron carrier in enzyme systems
    2. Involved in plant respiration
    3. Aids in utilizing iron
    4. Deficiency symptoms
        a. Young leaves permanently wilt without spotting or mottling.
        b. The twig or stalk just below tip and seedhead is often unable to stand erect in later stages of an acute shortage.

  D. The role zinc plays in plant growth
    1. Involved in the formation of some growth hormones
    2. Involved in the reproduction processes of certain plants
    3. Important to plant metabolism
    4. Deficiency symptoms

INFORMATION SHEET

    a. Leaf spots which involve areas between veins and eventually involving secondary and even primary veins.
    b. Leaves are thick
    c. The internodes are short

E. The role manganese plays in plant growth
  1. Essential in plant metabolism
  2. Essential for certain nitrogen transformations in plants.
  3. Deficiency symptoms:
    a. Spots of dead tissue are scattered over the leaf
    b. The smallest veins tend to remain green producing a check effect.

F. The role molybdenum plays in plant growth
  1. Acts as an electron carrier in enzyme systems which bring about oxidation reduction reaction in plants.
  2. Essential to plant development and reproduction.
  3. Does not take place in the absence of micro-nutrients.

VI. Factors That Determine Inorganic Fertilizer Selection
  A. Results of a soil test (send samples to local county agent).
  B. Checking plant tissue material at different stages of growth.
  C. Type of soil
  D. Cost of fertilizer
  E. Method of application
  F. Climate

VII. Features of Modern Inorganic Fertilizers
  A. Can be compounded to satisfy different user needs.
  B. Many pre-mixed commercial fertilizers available.
  C. By law a guaranteed analysis or chemical composition is listed on the bag or tag.
  D. Economical - effects are beneficial to growth while cost is low.

Commercial Inorganic Fertilizer Analyses and Corresponding Ratios

	Mineral Soils				Muck Soils		
Analyses	7-7-7	4-8-4	4-12-4	4-16-4	0-12-24	2-8-16	3-12-15
	8-8-8	5-10-5	5-15-5	5-20-5			
	10-10-10	6-12-6	6-18-6				
	14-14-14	8-16-8					
Ratio	1-1-1	1-2-1	1-3-1	1-4-1	0-1-2	0-4-8	1-4-5

Plant Food Removed by Major Crops

CROP	ACRE YIELD	POUNDS PLANT FOOD REMOVED		
		Nitrogen	Phosphate	Potassium
Corn (grain)	100 bu.	90	35	25
(stover)	3 tons	70	25	95
Cotton (seed, lint)	1,500 lbs.	40	20	15
(stalks, burrs, leaves)	2,000 lbs.	40	10	35
Wheat (grain)	40 bu.	50	25	15
(straw)	1.5 tons	20	5	35
Oats (grain)	80 bu.	50	20	15
(straw)	2 tons	25	15	80
Rice (rough)	80 bu.	50	20	10
(straw)	2.5 tons	30	10	70
Sugar Beets (roots)	20 tons	75	30	70
(tops)		70	30	100
Sorghum (grain)	60 bu.	50	25	15
(stover)	3 tons	65	20	95
Bermuda Hay (coastal)	8 tons	185	70	270
Bluegrass Hay	2 tons	60	20	60
Soybean (grain)	40 bu.	150	35	55
(straw)		30	10	25
Peanuts (nuts)	1.25 tons	90	10	15
(vines)	2.25 tons	105	25	95
Potatoes (tubers)	500 bu.	100	40	190
(vines)		125	20	140

FERTILIZERS

UNIT 3

ASSIGNMENT SHEET #1: Comparing Fertilizers

I. Do the following:

   A. Gather experimental data on the comparative advantages of commercial fertilizers, livestock manures, and green manure.

   B. Devise a chart arranging the above data so that the comparisons and differences can be easily seen.

   C. Instructor will evaluate.

FERTILIZERS

UNIT 3

ASSIGNMENT SHEET #2: Field Trip

I. Do the following:

   A. Visit a fertilizer supplier to observe different forms of commercial fertilizers and see the equipment needed to handle these fertilizers.

   B. List your findings.

   C. Instructor will evaluate.

FERTILIZERS

UNIT 3

TEST

1. Match the following terms with their corresponding definitions.

_____a. Micro-nutrient
_____b. Fertilizer
_____c. Complete Fertilizer
_____d. Incomplete Fertilizer
_____e. Commercial Fertilizer
_____f. Mixed Fertilizer
_____g. Chemical Fertilizer
_____h. Analysis
_____i. Translocation
_____j. Respiration
_____k. Ratio

1. Any material which supplies any essential plant food in an available form.
2. The movement or conduction of water soluble organic materials and minerals from one part of the plant to another
3. Fertilizer sold commercially containing (N, P, and K) in varying proportions.
4. Trace elements (minor plant foods).
5. An expression of the fertilizers composition.
6. Contains all three primary nutrients N, P, and K.
7. Synthesized from inorganic minerals.
8. When one or two of the primary elements are missing: 5-0-0 or 16-48-0.
9. Contains two or more of the nutrients necessary for plant growth.
10. The controlled break down or burning of glucose manufactured through photosynthesis to produce energy for plant growth processes.
11. The proportion of the primary elements (N, P, and K): 10-20-10 is 1-2-1.

2a. List the three primary fertilizer elements.

b. List three secondary fertilizer elements.

c. List seven secondary elements found in the soil.

TEST

3. Match the phrase(s) on the right which apply to the specific nutrient on the left.

a. Nitrogen

______ ______

b. Phosphorous

______ ______

c. Potassium

______ ______

1. Stimulates easy root formattion.
2. Necessary for chlorophyll manufacture.
3. Increases vigor and disease resistance to plants.
4. Essential to the formation and transfer of starches, sugars, and oils.
5. Produces a healthy green color.
6. Stimulates blooming.

4. Match the phrase(s) on the right which apply to the specific nutrient on the left.

a. Calcium

______ ______

b. Magnesium

______ ______

c. Sulfur

______ ______

1. Influences the intake of other plant nutrients.
2. Promotes root growth.
3. Essential to the formation of fats.
4. Essential to the formation of same protein.

5. Match the phrase on the right which apply to the specific nutrient on the left.

______a. Boron
______b. Iron
______c. Copper
______d. Zinc
______e. Manganese
______f. Molybdenum

1. Does not take place in absence of micronutrients.
2. Essential for certain nitrogen transformations in plants.
3. Involved in the reproduction processes certain plants.
4. Aids in iron utilization and is involved in plant respiration.
5. Essential to chlorophyll production
6. Influences water absorption.

6. List six factors which determine inorganic fertilizer selection.

TEST

7. Identify as True or False the following statements concerning the features of modern inorganic fertilizers.

______a. Inorganic fertilizer can not be compounded to satisfy different user needs.

______b. There are many different pre-mixed commercial fertilizers available to the user.

______c. By law the guaranteed chemical analysis of a fertilizer must be listed on the bag or tag.

______d. The cost of fertilizer today is often too expensive to justify its use or application.

FERTILIZERS

UNIT 4

METHODS OF FERTILIZER APPLICATION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify terms pertaining to methods of fertilizer application; to list five methods of applying commercial fertilizer, and state an example of each. The students will also be able to name methods of applying liquid fertilizer; to list two tests to determine soil deficiency; and name two mechanical methods of spreading fertilizers. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms that relate to methods of fertilizer application.
2. Name five methods of applying fertilizers.
3. Choose from given statements those that pertain to the broadcast method of applying fertilizer.
4. Select from given statements those that pertain to the row method of applying fertilizer.
5. Choose from given statements those that pertain to the side placement method of applying fertilizer.
6. Select from given statements those that pertain to the perforated method of applying fertilizer.
7. List three ways that liquid fertilizer is applied to the soil.
8. Choose from given statements those that pertain to the direct method of applying fertilizer.
9. Select from given statements those that pertain to the foliage spray method of applying liquid fertilizer.
10. Choose from given statements those that pertain to the irrigation-water method of applying fertilizer.
11. Name two mechanical methods of spreading fertilizers.

FERTILIZERS

UNIT 4

INFORMATION SHEET

I. Terms and Definitions

  A. Starter Solution - Made up of chemicals that are water soluble and used when transplanting herbaceous crops to stimulate the rate of root regeneration.

  B. Anhydrous ammonia - Enters the soil in liquid form and turns to gas which under warm, moist conditions, changes to nitrate-nitrogen.

  C. Iron chelates - A water-soluble form of micro-nutrient used for correction of iron deficiency in crops and ornamentals in slightly acid to slightly alkaline soils.

  D. Furrow - A trench made in the earth by a plow. Used to distribute water to the plants along the entire length.

II. Methods of Applying Commercial Fertilizers

  A. Broadcast

  B. Row

  C. Side Placement

  D. Perforated

  E. Liquid

  F. Tablet (slow release)

III. The Broadcast Method of Applying Fertilizer - Used in fertilizing crops that are grown close together, such as small grains, cover crops, spinach, carrots, onions, lilies, gladiolas.

  A. Evenly applied over the entire surface of the soil.

  B. Applied after the land is plowed but before it is harrowed.

IV. The Row Method of Applying Fertilizer - Used mostly in southern U.S. for flower and vegetable crops.

  A. Fertilizer is placed at the bottom of the furrow 10 days before planting.

  B. This places the fertilizer directly below the plants.

  C. Disadvantage - roots of plants can become injured by the fertilizer salts.

V. The Side Placement Method of Applying Fertilizer - Used by commercial growers of tomatoes.

  A. Fertilizer is applied in a continuous band on one or both sides, just below the row of seeds or plants.

B. The seedlings have a relatively large quantity of available, essential raw materials at an early stage of development.

C. Small quantities of fertilizer can be used with the maximum of results.

VI. The Perforated Method of Applying Fertilizers - Used for growing ornamental trees.

A. Fertilizer is placed in small, drilled holes, 12 to 18 inches deep at the base of the trees.

B. Tree roots receive the fertilizer; does not influence the growth of grasses and plants under the trees.

VII. The Liquid Method of Applying Fertilizer.

A. Fertilizer is applied direct to soil.

B. Fertilizer is applied as a foliage spray.

C. Fertilizer is applied with irrigation water.

D. Usually used to supply trace elements to secondary nutrients.

VIII. When to Use the Direct Soil Method of Applying Liquid Fertilizer.

A. Used to supply relatively large quantities of essential raw materials close to plant roots.

B. Used to supply relatively cheap source of nitrogen, under certain conditions.

C. Example: This method is used for applying starter solution (transplanting) and anhydrous ammonia (a profitable source of nitrate-nitrogen when applied in a liquid form is immediately available to the plant roots.)

IX. When To Use The Foliage Spray Method of Applying Liquid Fertilizer.

A. Used to correct a deficiency of some essential element in a relatively short time.

B. Used to supply essential raw materials which, if applied to soils, would for some reason or other become unavailable to the plants.

C. Example: Sprays containing magnesium sulfate have corrected magnesium deficiency of apple trees and cantaloupe; sprays containing iron chelates have corrected iron deficiency of citrus trees.

X. When to Use the Irrigation Water Method of Applying Fertilizers.

[illegible] Used in placing fertilizer in solution with water before it is pumped through the irrigation systems.

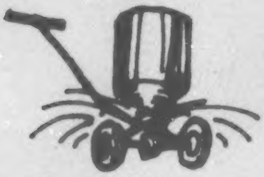
B. Used in forcing a concentrated solution of the fertilizer into the irrigation lines at the time water is pumped.

INFORMATION SHEET

C. **Example:** Compounds which dissolve readily in water and which change to nitrate in short time are sodium nitrate, ammonium nitrate, ammonium sulfate, and urea.

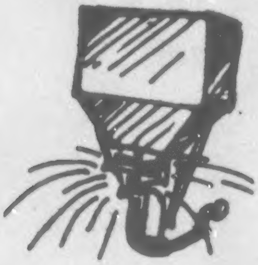
XI. Basic Mechanical Methods of Applying Fertilizer.

A. By Lawn Spreader.



1. Uses only pelleted or granular commercial fertilizers, seeds, and pesticides.
2. Area covered, six to eight feet.
3. Designed for accurate precision spreading.

B. By Heavy-duty Spreader.



1. Uses only pelleted or granular commercial fertilizers, seeds, and pesticides.
2. Area covered, up to forty feet.
3. Designed for accurate precision spreading.

FERTILIZERS

UNIT 4

ASSIGNMENT SHEET #1: Committees on Fertilizer Sources.

I. Do the Following:

A. Students work in committees to gather information concerning fertilizer sources: raw materials, manufacturing processes, transportation and storage, special equipment needed, relative cost, and methods of application, product availability and safety.

B. Each committee write up a brief report, and appoint one committee member to inform the rest of the class as to findings.

C. Instructor will evaluate.

FERTILIZERS

UNIT 4

ASSIGNMENT SHEET #2: Mechanical Means of Spreading Fertilizers (or Seeds)

I. Do the Following:

A. Visit a fertilizer supplier or farm machinery dealer and become acquainted with the different types of fertilizer spreaders on the market. List the advantages and disadvantages of each type.

B. Instructor will evaluate.

FERTILIZERS

UNIT 4

ASSIGNMENT SHEET #3: How to Determine Required Amount of Fertilizer.

I. Given the following information, determine the amount of fertilizer needed for one acre on an acre basis.

A. 400 pounds of nutrients wanted per acre.

B. Percentage of nutrients in the fertilizer (20-15-5).

C. To cover 10 acres.

D. Show computation,

E. Give number of pounds needed per acre.

F. Give number of 100 pound bags per acre.

G. Give number of tons needed for 10 acres.

H. Formula:

$$\text{acre basis} = \frac{\text{Pounds of nutrient wanted}}{\text{Percentage of nutrient in fertilizer}} \quad \text{pounds needed per acre}$$

II. Given the following information, compute the amount of fertilizer needed per square foot on the square footage basis.

A. Nutrient rate - 25-10-5

B. Number of square feet - 3000

C. Number of square feet per acre - 43,560

D. Show computations.

E. How many pounds per square foot?

F. Formula:

$$\text{Square Footage Basis} = \frac{\text{(Nutrient Rate) (Number of Square Feet)}}{\text{Number of Square feet per acre}} = \text{Pounds needed Per square foot}$$

FERTILIZERS

UNIT 4

ASSIGNMENT SHEET #4; Fertilizer Cost Determination.

I. Given the following information, calculate the cost of fertilizer per pound of nutrient.

   A. Fertilizer analysis equals pounds of nutrient per 100 pounds.

   B. Fertilizer analysis is 20-10-10.

   C. Fertilizer cost is $100.00 per ton.

   D. What is the cost per pound of nutrient? (Show computations)

FERTILIZERS

UNIT 4

TEST

1. Match:

_____ a. Iron Chelates

_____ b. Starter solution

_____ c. Furrow

_____ d. Anhydrous Ammonia

1. Enters the soil in liquid form and turns to gas which under warm, moist conditions changes to nitrate-nitrogen.

2. A water-soluble form of a micronutrient used for correction of iron deficiency in crops and ornamentals in slightly acid to slightly alkaline soils.

3. Made up of chemicals that are water soluble and is used when transplanting herbaceous crops to stimulate the rate of root regeneration.

4. A trench made in the earth by a plow.

5. A metal paddle that is used to stir soil so that growth will be faster.

2. Name six methods of applying fertilizers.

3. Check statements below that pertain to the use of the broadcast method of applying fertilizer.

_____ a. Fertilizer is applied evenly over the entire surface of the soil.

_____ b. Fertilizer is applied before the land is plowed.

_____ c. Fertilizer is applied after the land is plowed but before it is harrowed.

_____ d. This method is used to apply essential raw material to widely spaced crops.

_____ e. This method is used to apply essential raw material to closely growing crops.

_____ f. This method is used for spinach and lilies.

_____ g. This method is used for apples and oranges.

4. Check statements below that pertain to the use of the row method of applying fertilizer.

_____ a. Fertilizer is placed along the sides of a furrow just before planting.

TEST

_____b. Fertilizer is placed in the bottom of a furrow ten days before planting.

_____c. Fertilizer should be directly below plants.

_____d. Fertilizer should be around the side of the plants.

_____e. This method makes a large quantity of raw materials available to plants at an early stage of life.

_____f. This method can result in damage of plant roots by fertilizer salts.

_____g. This method is used often for flower and vegetable crops.

5. Check statements below that pertain to the use of the side placement method of applying fertilizer.

_____a. Fertilizer is applied in a continuous band along the sides and just below the seeds or plants.

_____b. Fertilizer is applied on the soil surface along side of each plant.

_____c. This method makes a large quantity of raw materials available to plants at an early stage of life.

_____d. This method can damage roots with fertilizer salts.

_____e. This method is used mostly for the growing of apricots.

_____f. This method is used mostly for the growing of tomatoes.

_____g. This method is used mostly for the growing of potatoes.

6. Check statements below that pertain to the perforated method of applying fertilizers:

_____a. Fertilizer is placed into holes drilled in the trunk of a tree.

_____b. Fertilizer is placed into holes places around the tree.

_____c. This method helps to insure that the fertilizer gets to the phloem.

_____d. This method helps to insure that the fertilizer gets to the roots rather than the grasses around the tree.

_____e. This method is used for the growing of all trees and shrubs.

_____f. This method is used mostly for the growing of grassy areas around trees.

7. Name three ways by which liquid fertilizer is applied to soil.

8. Check statements below that pertain to the direct-soil method of applying liquid fertilizer.

_____a. Supplies large quantities of essential raw materials close to plant roots.

TEST

_____b. Supplies a relatively cheap source of nitrogen.

_____c. This method is used for applying starter solutions.

_____d. This method is used for applying anhydrous ammonia.

_____e. Supplies large quantities of essential raw material to leaves immediately.

_____f. This method is more expensive than any other method.

_____g. This method is ecologically unsound because it gets the soil too wet.

9. Check statements below that pertain to the foliage-spray method of applying liquid fertilizer.

_____a. This method is used to correct a deficiency of some essential element in a relatively short time.

_____b. This method takes longer than any other method.

_____c. This method is used to supply raw material that would not become available to the plant if it were applied to the soil.

_____d. This method gets the leaves too wet.

_____e. This method enables correction of magnesium deficiency in apple trees.

_____f. This method enables correction of iron deficiency in citrus trees.

_____g. This method enables selective killing of damaging insects.

10. Check statements below that pertain to the irrigation-water method of applying liquid fertilizer.

_____a. In this method the fertilizer is already in solution before it is pumped.

_____b. In this method a weak fertilizer solution is sprinkled into the irrigation lines.

_____c. In this method a concentrated solution is forced into the irrigation lines.

_____d. This method uses compounds that do not change to a nitrate in a short time.

_____e. This method uses compounds that do not dissolve easily.

_____f. This method uses compounds that change to a nitrate in a short time.

_____g. This method uses compounds that dissolve easily.

11. Name two basic mechanical methods of spreading fertilizers.

FERTILIZERS
UNIT 5
SOIL SAMPLING

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to demonstrate the proper procedure for obtaining a representative soil sample from a given field and prepare this sample for mailing and/or processing. This objective will be considered achieved upon completion of the jobs assigned, and the attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match terms associated with soil testing with the proper definitions.
2. State two chemical tests to determine fertilizer needs and what each test discloses.
3. Complete a given incomplete statement to make an accurate statement about a plant tissue test.
4. Explain in writing reasons for testing soil.
5. Select from a list the major chemical properties for which soils are tested.
6. Select the procedure for collecting representative soil samples from a given field.
7. Select from a list areas in which soil samples should not be taken.
8. Name items of information which should be submitted with soil samples, in order for proper fertilizer recommendations to be made.
9. Identify four tools used in collecting soil samples.
10. Name two locations in Kansas where soil samples can be sent for testing.
11. Demonstrate the ability to secure a soil sample and prepare it for mailing or processing.

FERTILIZERS

UNIT 5

INFORMATION SHEET

I. Terms and Definitions

A. Fertilizer - Any natural or manufactured material added to the soil in order to supply one or more plant nutrients.

B. Fertilizer analysis - Refers to the minimum percentage of nitrogen, available phosphorus, and water soluble potash in a fertilizer.

C. Soil pH - Refers to the degree of acidity or alkalinity of a soil

(NOTE: "pH" is an abbreviation for "potential hydrogen"; used chemically to express the hydrogen ion concentration of a solution.)

D. Alkaline soils - Soils having a pH reading above 7.0.

E. Acidic soils - Those soils having a pH reading less than 7.0.

(NOTE: Each pH unit below 7.0 indicates an increase in acidity of ten times over the preceeding pH value. Each unit above 7.0 indicates ten times increase in alkalinity.)

F. Organic matter - That fraction of soil which results from decomposition of vegetable and animal matter through the action of bacteria.

(NOTE: The nitrogen in soil is largely stored in the organic matter.)

G. Soil test - A chemical means of determining the nutrient supplying power of a soil.

II. Chemical Tests to Determine Fertilizer Need

A. Soil test - Determines degree of fertility of the soil.

B. Plant Tissue Test - Determine what essential elements are lacking and/or unavailable in the soil.

III. Plant Tissue Test.

A. After receiving the results from sending a plant tissue sample to the county agent, the proper fertilizer can be selected.

IV. Reasons for Soil Testing

A. Estimates how much a particular nutrient the soil will provide to a crop.

B. Determines the balance of available plant food nutrients.

C. Measures the degree of soil acidity and soil alkalinity.

V. Major Chemical Properties for which Soils are Tested.

A. Phosphorus

B. Potassium

C. Nitrogen

(NOTE: The test is often for organic matter since nitrogen is almost in direct proportion to organic matter.)

D. Calcium

E. Magnesium

F. Hydrogen ion concentration - pH test

VI. Procedure for Collecting Representative Soil Samples for a Given Field (TM 1, 2, and 3).

A. Divide fields to be sampled into uniform areas of not more than ten acres.

(Note: Uniform areas may be divided into forty acres.)

B. Samples should be taken from plow depth in cropland and from the top two or three inches in pasture land.

C. Samples of uniform size should be put in a bucket and mixed.

(Note: If tests are to be made for micronutrients use only a clean plastic bucket.)

D. Approximately five to ten samples should be taken in each field or area.

E. Approximately one pint of the mixed soil should be placed in a suitable container.

(Note: A small plastic bag is ideal.)

VII. Areas from which Soil Samples Should Not be Taken

A. Eroded spots

B. Areas with visible differences in soils

C. Small areas of noticeable differences in crop growth within field

D. Back Furrows

E. Small depressions

F. Areas in field that haven been manured, limed, or otherwise treated differently

G. Fence rows

H. Road beds

VIII. Information Submitted with Sample

A. Name of county

B. Name and address of farmer

C. Size and location of field

D. Fertilizer history

E. Cropping history

INFORMATION SHEET

- F. Crop to be grown
- G. Expected yield

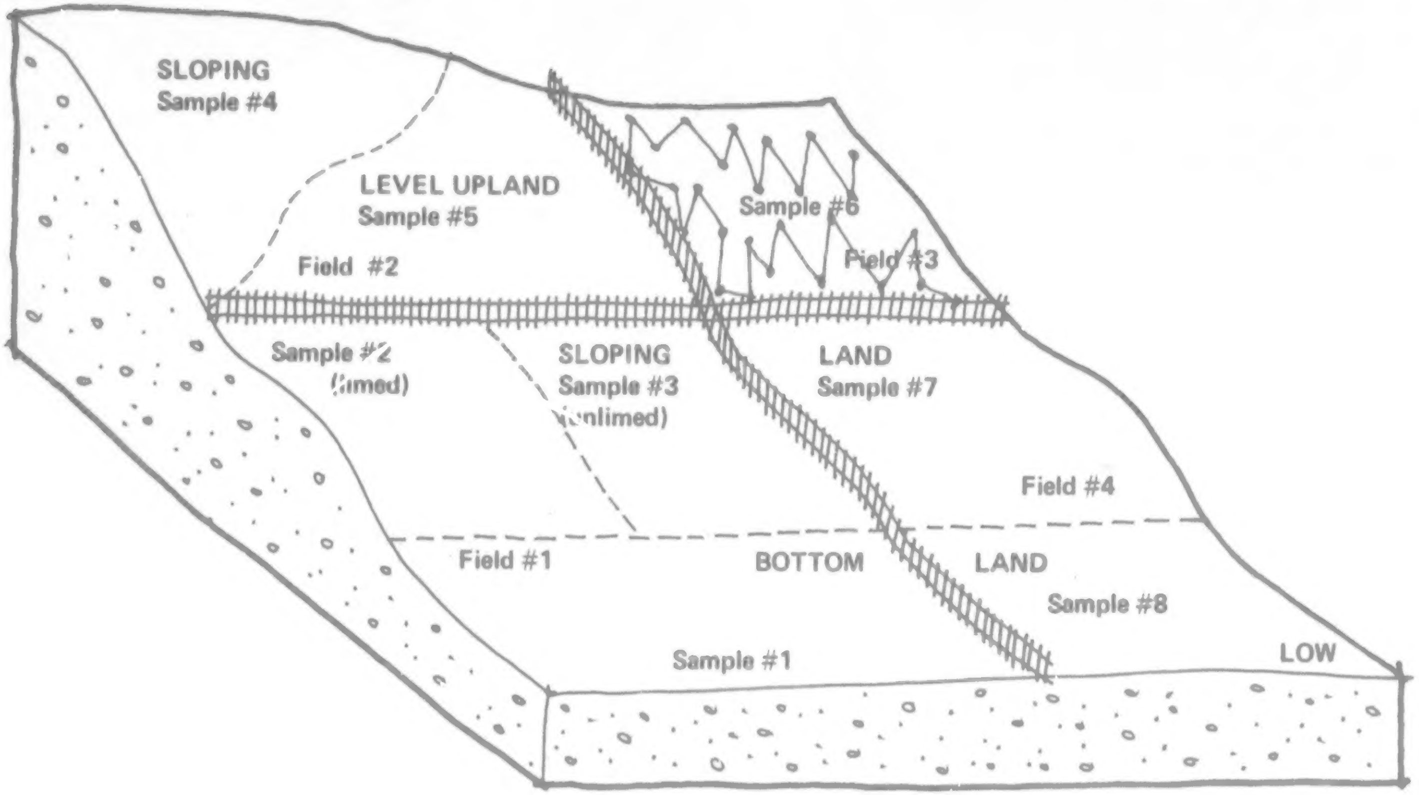
IX. Tools Used in Collecting Samples (TM 4)

- A. Soil probe
- B. Spade
- C. Trowel
- D. Soil auger

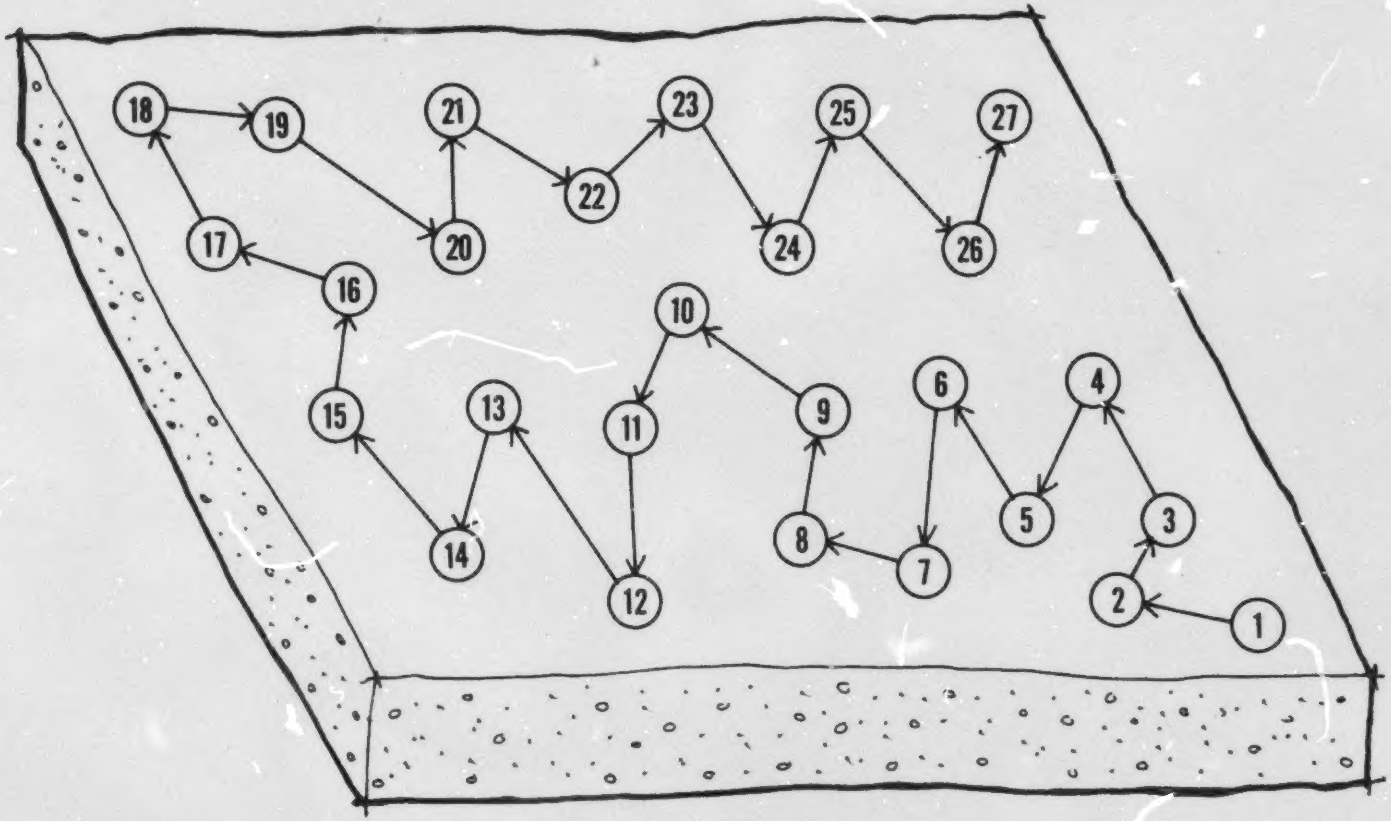
X. Location Where Soil Samples Can be Sent for Testing

- A. County Ag Extension Agent
- B. Agronomy Department, Kansas State University, Manhattan, Kansas.
- C. Local Fertilizer Distrubutor

Field Divided into Uniform Areas for Soil Testing


SLOPING
Sample #4
LEVEL UPLAND
Sample #5
Sample #6
Field #2
Field #3
Sample #2
(limed)
SLOPING
Sample #3
(unlimed)
LAND
Sample #7
Field #4
Field #1
BOTTOM
LAND
Sample #8
Sample #1
LOW

Pattern for Obtaining Cores for a Soil Sample from One Field


1
2
3
4
5
6
7
8
9
10
11
12
13
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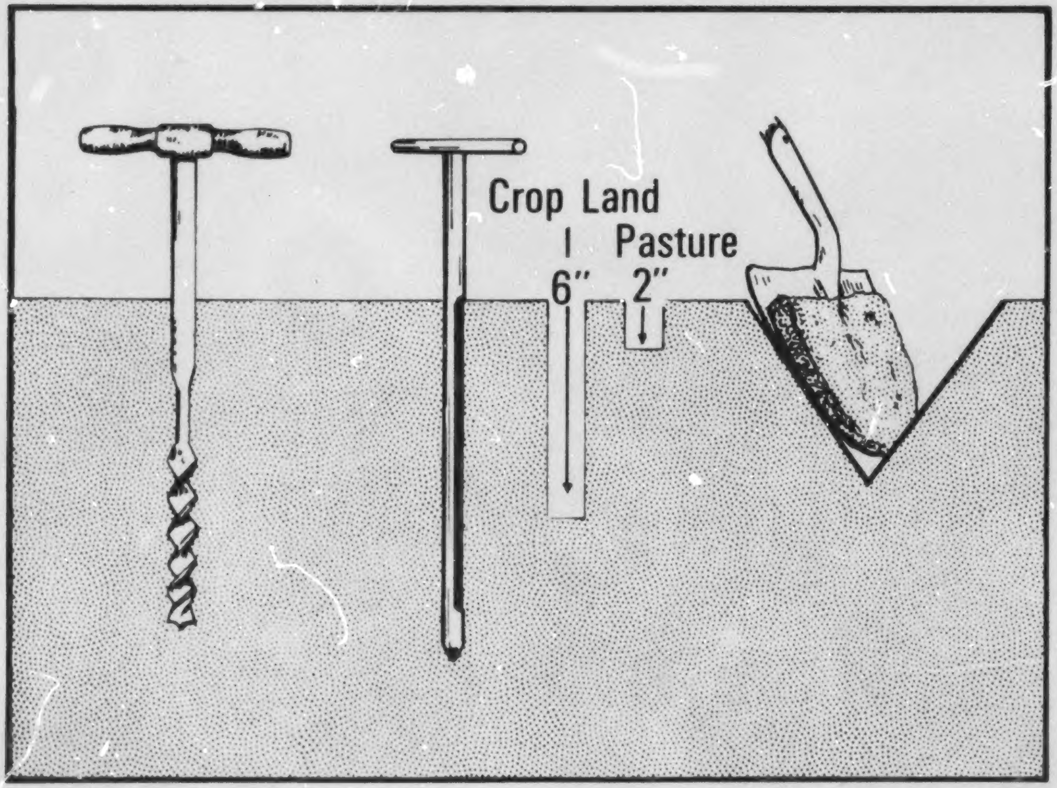
27

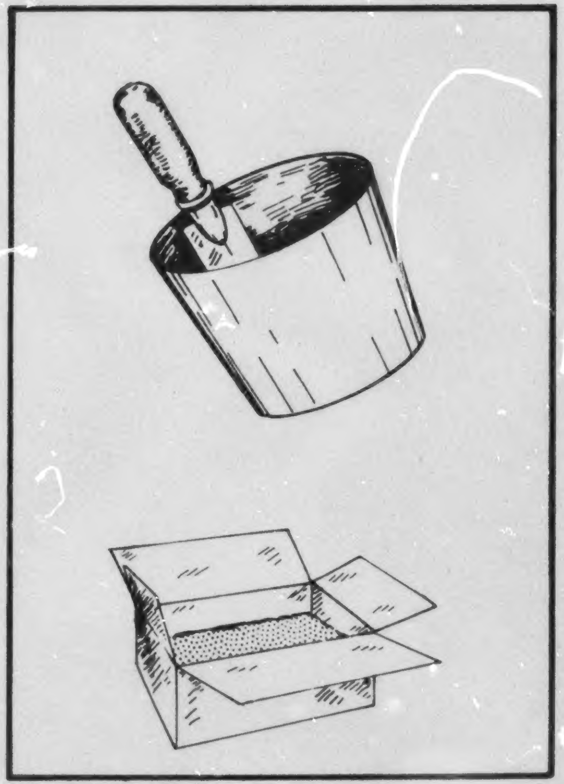
TM 2

HORTII SE U5-8

Using Sampling Tools


Crop Land
6"
Pasture
2"

Use Proper Sampling Tools

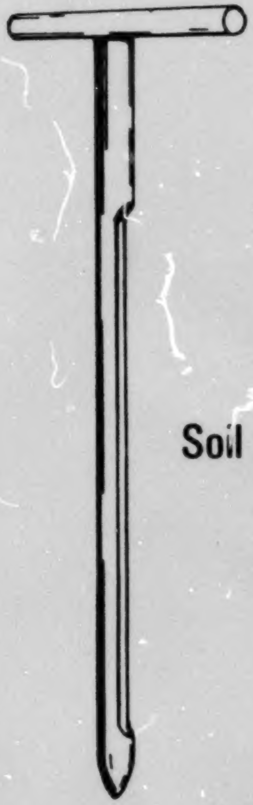


Mix Well in a Clean Pail

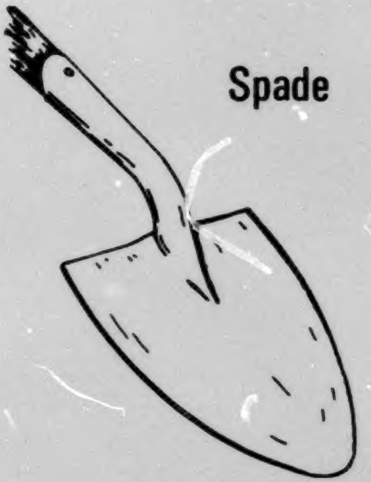
TM 3

HORTII SE U5-9

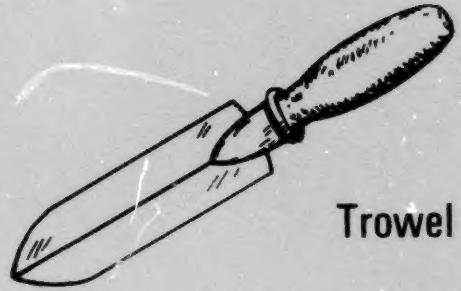
Tools Used in Collecting Samples



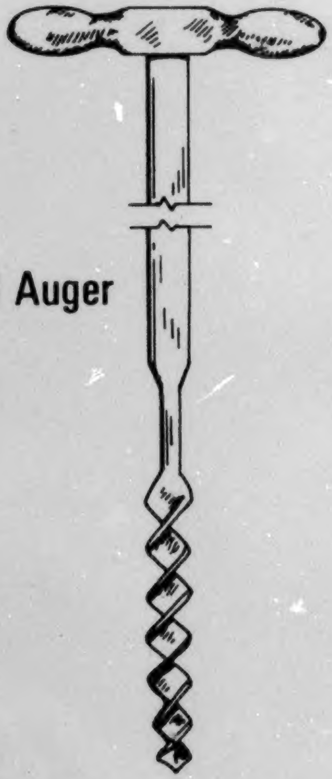
Soil Probe



Spade



Trowel



Soil Auger

Soil Sample Information

SOIL TESTING LABORATORY
Agronomy Department
Kansas State University
Manhattan, Kansas 66506

and

SOIL TESTING LABORATORY
Garden City Branch Expt. Sta
Kansas State University
Garden City, Kansas 67846

Name: ______________________________

Address: ______________________________
(Street or Route)

____
(City and State) Zip Code

County: ______________________________

Legal Description: ______________________________

Date: ________ / ________ 19 ____

Sample(s) Submitted by: (If different than name at left)

Name ______________________________

Address: ______________________________
(Street or Route)

____
(City and State) Zip Code

Fee Payment: Enclosed $ ________ Account No ________

For Laboratory Use Only

Fee Payment: ______________________________

Date Received: ____________________ 19 ____

Date Results Reported: ____________________ 19 ____

SAMPLE IDENTIFICATION					SOIL DESCRIPTION			IRRIGATION		PREVIOUS TREATMENTS							TEST DESIRED (✓) Refer to Fee Schedule						
										Last Year					Lime								
Laboratory Number (Do not write below)	Field Number or Letter	Sample Number or Letter	Depth i.e. 0-6" 0-24" 6-24"	Acres Represented by Sample	Slope L—level G—gentle S—steep I—irregular	Drainage P—poor G—good E—excessive	Soil Type i.e. Geary Silt Loam	Type Sprinkler Surface	Leveling None Moderate Severe	Nitrogen (N) lbs./A.	Phosphate (P_2O_5) lbs./A.	Potash (K_2O) lbs./A.	Zinc (Zn) lbs./A.	Manure or Other Nutrients T./A. or lbs./A.	Last Three Years	Rate E.C.C lbs./A	General Fertility	Available Nitrogen	Available Zinc	Available Iron	Combi. Avail. Zinc & Iron	Organic Matter	Lawn or Garden
															19___								
															19___								
															19___								
															19___								

MAP OF SAMPLE LOCATION ON FARM

		CROP HISTORY				DESIRED RECOMMENDATION			REMARKS
		Last Year		Two Years Ago					Note any special conditions of the soil or crops.
Field Number or Letter	Sample Number or Letter	Crop	Yield bu./A. or T./A.	Crop	Yield bu./A. or T./A.	Crop to be Fertilized	Yield Goal bu./A or T./A	Crop Next Year	

DO NOT DETACH

RETURN ALL 4 PARTS. THE ORIGINAL
WILL BE RETURNED TO YOU.

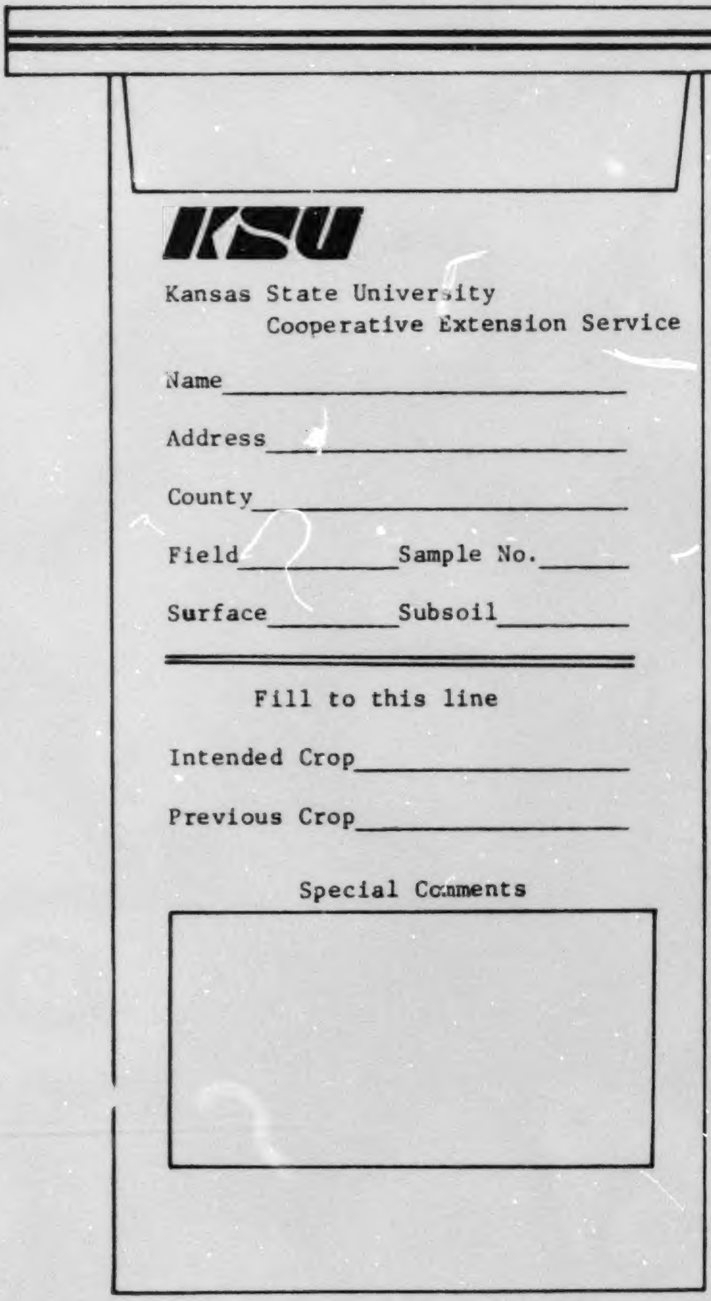
HORTII SE U5-11

29

TM 6

293

SOIL SAMPLE CONTAINER



KSU

Kansas State University
Cooperative Extension Service

Name____________________

Address____________________

County____________________

Field________ Sample No.______

Surface________ Subsoil________

Fill to this line

Intended Crop________________

Previous Crop________________

Special Comments

FRONT

Procedure for taking Soil Samples

1. Sample each distinctly different soil area separately which has had the same crop, fertilizer and lime treatment.
2. Use a soil sampling tube, auger or spade to collect 20 or more equal-sized cores or slices
3. Mix sample thoroughly in a clean bucket (plastic for micronutrient) and air dry sample as soon as possible if available nitrogen test is desired.
4. Fill this bag to line with mixture and label plainly.
5. Complete the soil sample information sheet provided by the laboratory.
6. Take samples to your local county Extension office for forwarding to the laboratory.

BACK

SOIL TESTS AVAILABLE

SUPPLEMENTAL INFORMATION SHEET

The various tests availible from the soil testing laboratories are described briefly below. Read through the description of each test and mark on the information sheet which tests you desire on your samples.

GENERAL FERTILITY

This test is recommended where crops grow normally, but you desire to know the amount of lime, if any, and the kind and amount of fertilizer needed for optimum plant growth. The test includes determinations for pH, lime requirement on those samples with a pH of 6.4 or less, available phosphorous, and exchangeable potassium.

The results of the general fertility test may be supplemented by one or more of the tests listed below. On a majority of the soils in Kansas this test will be adequate.

AVAILABLE PROFILE NITROGEN

This test is recommended on areas which are suspected of having appreciable accumulations of inorganic nitrogen (nitrates plus ammonium). Continuous heavy applications of commercial notrogen fertilizer and or heavy rates of manure may give accumulations of available nitrogen where yields have not been high proportional to the nitrogen applied. Under summer fallow conditions, appreciable quantities may also accumulate.

Because nitrates are water soluble, movement of the nitrate down in the profile will occur when moisture penetrates into the soil. Thus smaples deeper than plow depth are necessary for a reliable test. In addition to the surface plow layer sample, an additional sample to at least 24 inches is necessary for this test. Deeper samples would be very desirable. Record the depth of sampling on the information sheet. The available nitrogen test will not be made without samples to at least 24 inches. If available nitrogen is desired in addition to the general fertility test, then the surface soil sample plus the subsoil sample must be submitted to the lab. If only available nitrogen is desired, then only one sample to a depth of at least 24 inches is necessary. The samples must be air dried as soon as possible to stop microbial activity. This means spreading the sample on a clean sheet of paper or plastic to dry before sending the sample to the laboratory.

CAUTION: Be certain the sample is not contaminated by fertilizer dust manure, salt, etc. Sample should be dry within 24 hours.

TM

(continued)

SUPPLEMENTAL INFORMATION SHEET

AVAILABLE ZINC

This test is recommended on areas under high yield potential for corn or grain sorghum which by erosion, terracing, or leveling for irrigation have had the topsoil removed. Sandy soils low in organic matter under high yield conditions also should be checked for zinc content. Wheat, alfalfa, and pastures are not likely to respond to zinc so this test is not recommended for these crops. Also additional research is needed before zinc is recommended for soybeans or sugar beets.

ORGANIC MATTER

The organic matter in the soil is the storehouse of most of the nitrogen, sulfur, and several of the micronutrients. The rate of release of thses nutrients to plant available forms is dependent on environmental conditions. Organic matter results can be very meaningful to agronomists in better understanding the soil conditions on your farm. Organic matter levels can be useful in determing rates of herbicides. This test is not recommended on all samples, but only in cases where the additional information is desired.

LAWN OR GARDEN

This test is a combination of the general fertility and available nitrogen tests made only on a surface soil sample. The results should be very useful in determining the amount of lime and fertilizer to apply for best plant growth.

OTHER TESTS AVAILABLE

The soil testing laboratories also offer tests for salt and alkali, and irrigation water quality. Check with your local county agen on desirability of these tests and instructions for sample collection.

TESTING FEE FOR EACH TEST

General Fertility	$1.50
Available Profile Nitrogen (Two samples - top and subsoil)	2.00
Available Zinc	3.00
Organic Matter	.50
Lawn and Garden	2.00
Salt and Alkali (Three sample profile - $3 each)	9.00
Irrigation Water Quality	1.00

Prices effective January

FERTILIZERS

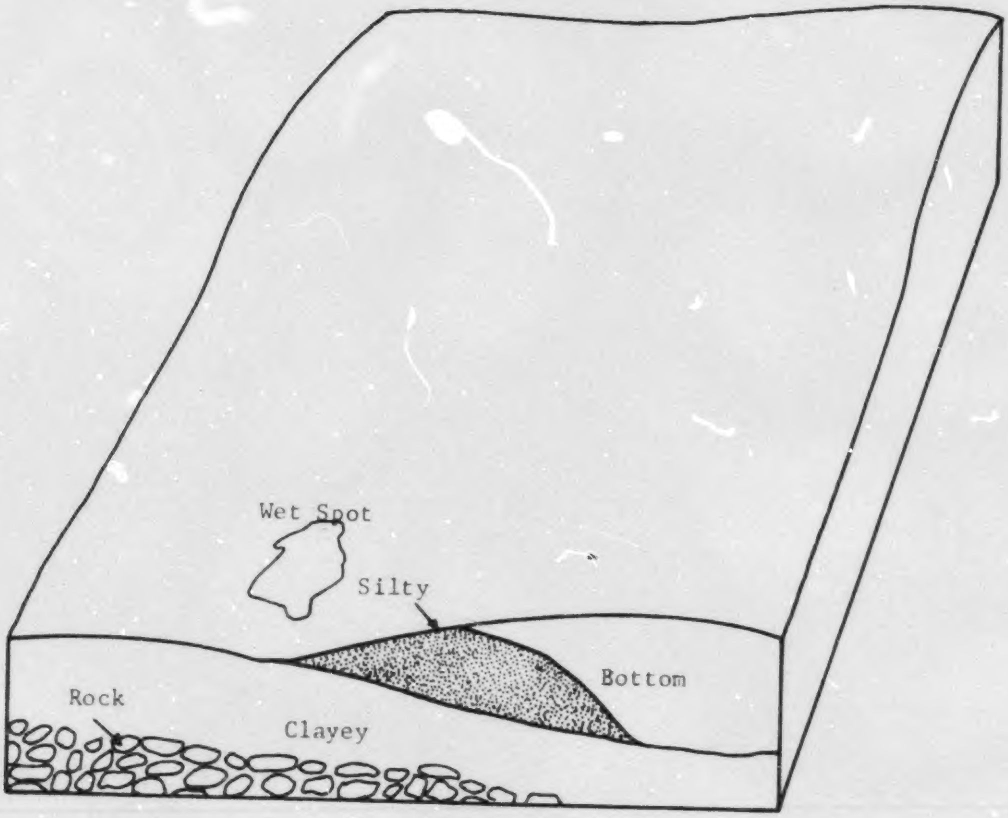
UNIT 5

ASSIGNMENT SHEET #1: Selecting Sampling Sites

Using the drawing below, complete the following tasks. When completed return it to the instructor for evaluation.

1. Divide a field into sampling areas.

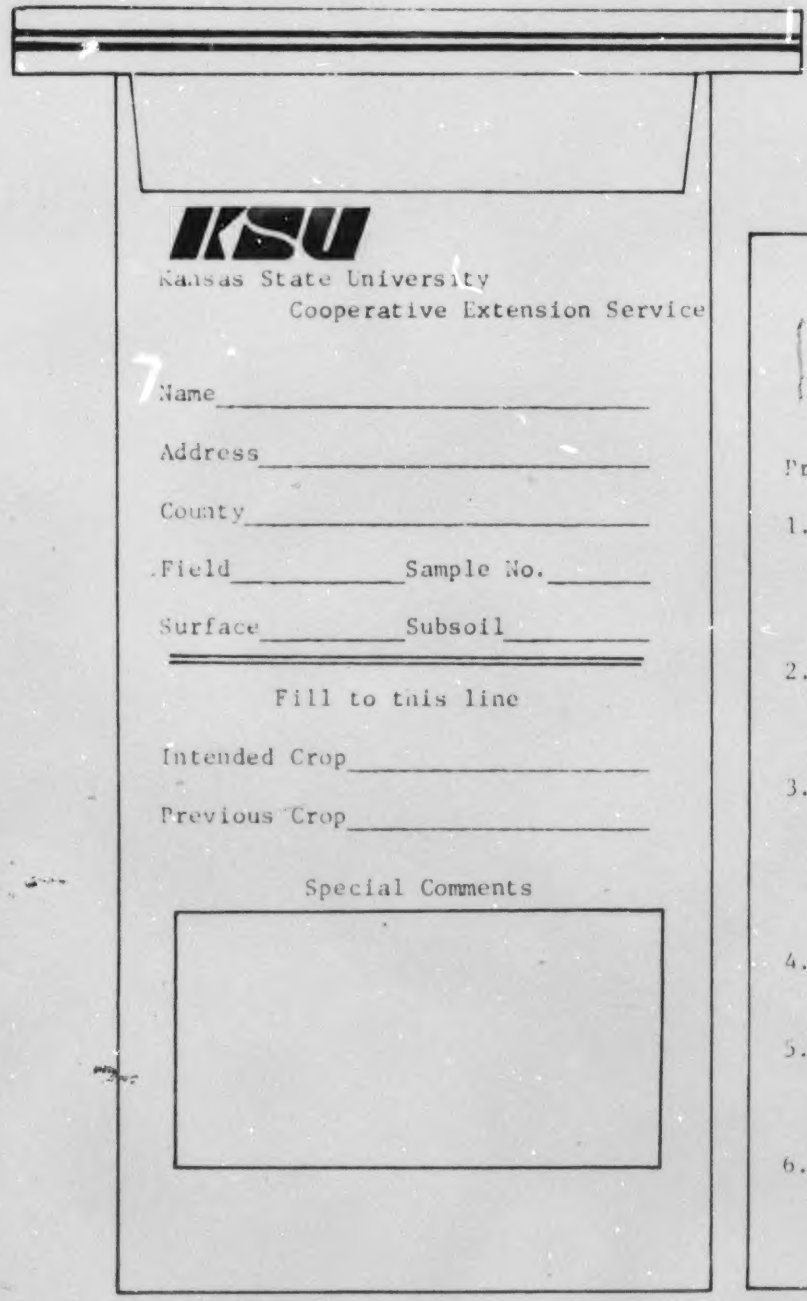
2. Place a small number on each sampling site within one of the divided areas.



FERTILIZERS
UNIT 5
ASSIGNMENT SHEET #2: Securing a Soil Sample

Take a soil sample and return it to the instructor for evaluation.

Collect a soil sample according to directions on this soil sample container.



Kansas State University
Cooperative Extension Service

Name ____________________

Address ____________________

County ____________________

Field __________ Sample No. ________

Surface ________ Subsoil ________

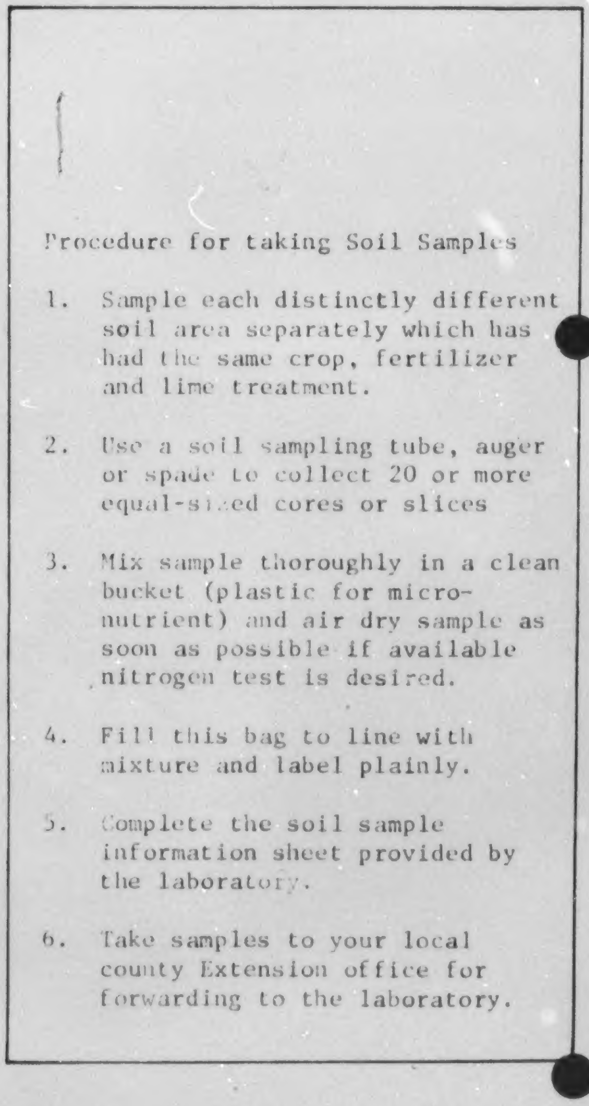
Fill to this line

Intended Crop ____________________

Previous Crop ____________________

Special Comments

FRONT



Procedure for taking Soil Samples

1. Sample each distinctly different soil area separately which has had the same crop, fertilizer and lime treatment.
2. Use a soil sampling tube, auger or spade to collect 20 or more equal-sized cores or slices
3. Mix sample thoroughly in a clean bucket (plastic for micronutrient) and air dry sample as soon as possible if available nitrogen test is desired.
4. Fill this bag to line with mixture and label plainly.
5. Complete the soil sample information sheet provided by the laboratory.
6. Take samples to your local county Extension office for forwarding to the laboratory.

BACK

FERTILIZERS

UNIT 5

TEST

1. Match the terms on the right to the correct definition.

_____a. Refers to the degree of acidity or alkalinity of a soil

_____b. Refers to the minimum percentage of nitrogen, available phosphorus, and water soluble potash in a fertilizer

_____c. Any natural or manufactured material added to the soil in order to supply one or more plant nutrients

_____d. Soils having a pH reading of above 7.0

_____e. A chemical means of determining the nutrient supplying power of a soil

_____f. Those soils having a pH reading less than 7.0

_____g. That fraction of soil which results from decomposition of vegetable and animal matter through the action of bacteria

1. Fertilizer
2. Soil pH
3. Organic matter
4. Soil test
5. Acidic soils
6. Alkaline soils
7. Fertilizer analysis

2. State two chemical tests to determine fertilizer needs and what each test discloses.

3. Complete the following statement to make an accurate statement about a plant tissue test; To enable a plant tissue test to tell what fertilizer should be used, you have to send a _________________ sample to the___________.

4. Explain in writing two reasons for testing soil.

5. Select from the list below, four major chemical properties for which soils are tested. (Circle the correct answers.)

a. Nitrogen

b. Calcium

c. Zinc

d. Manganese

e. Phosphorus

f. Iron

g. Potassium

TEST

6. Place an "X" in the blank to select the procedure to use for collecting a representative soil sample.

_____a. Five to ten samples should be taken in each field or area.

_____b. Divide fields to be sampled into uniform areas of not more than sixty acres.

_____c. Samples should be taken from the depth of six to eight inches in cropland and pasture land.

_____d. Samples of uniform size should be placed in a bucket and mixed.

_____e. Approximately one quart of the mixed soil should be placed in a suitable container.

7. Select from the list below, areas from which samples should not be taken. (Circle the unsuitable sites.)

a. Bottom land

b. Fence rows

c. Pasture land

d. Upland

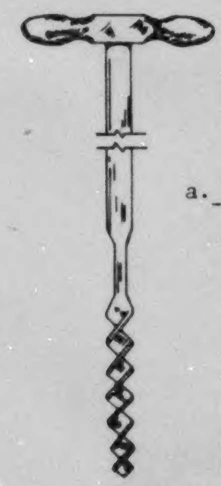
e. Back furrows

f. Eroded spots

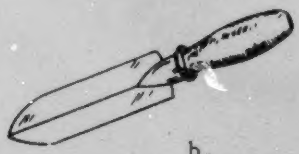
g. Acid soils

8. Name five items of information that should be submitted with the soil sample, in order to make proper fertilizer recommendations.

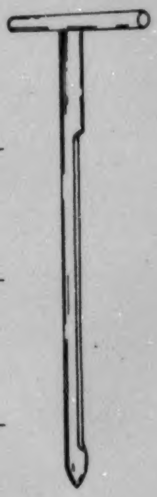
9. Identify four sampling tools.



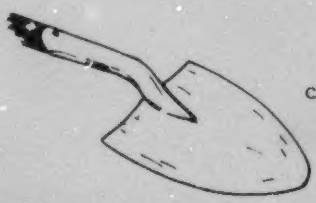
a. ____________________



b. ________________



d. ________________



c. ________________

TEST

10. Name two locations in Kansas where soil samples can be sent for testing.

11. Demonstrate the ability to secure a soil sample and prepare it for mailing or processing.

GREENHOUSE

UNIT L

POT PLANT PRODUCTION

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to develop plant production schedules to fit greenhouse space availability. In addition the students will be able to carry out those plans. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define terms and definitions concerning pot plant production.
2. Name two categories of pot plant production operations.
3. Select from a list those items which are required for producing pot plants.
4. Select from a list those plants that are common pot plants.
5. List two methods of plant growth regulation.
6. List three means of controlling pests and diseases in the greenhouse and give an example of each.
7. Plan pot plant production rotations and schedules. (Assignment Sheet #1)

GREENHOUSE

UNIT 1

INFORMATION SHEET

I. Terms and Definitions

A. Class - A subgroup of a plant species, having similar shaped and sized flowers.

B. Cultivar - Cultivated plants that can be reproduced to give identical plants usually given a name, a variety.

C. Dormant - not in active state of growth.

D. Inflorescence - A cluster of flowers.

E. Bracts - Brightly colored, leaf-like organs surrounding the true flowers.

F. Stock plant - A plant used as a source of cutting.

II. Categories of Pot Plant Production

A. Those which are produced and used throughout the year - mums, African violets, foliage plants.

B. Seasonal plants - poinsettia, Easter lilies.

III. Pot Plant Requirements

A. Plant production schedule.

B. Benches 30" high and no wider than 6 feet is worked from both sides.

C. Potting and shipping areas large enough to accommodate number of plants being handled.

D. Unlimited supply of growing media must be available.

E. Correct fertilization program according to soil tests is needed.

F. Correct watering schedules according to needs of the plant are a must.

G. Correct pest control procedures are necessary.

IV. Common Pot Plants

A. Mums

B. Azaleas

C. Poinsettias

D. Hydrangeas

E. Lilies

F. Gloxinias

G. African violets

H. Pothos

I. Philodendron

INFORMATION SHEET

J. Cacti

K. Diffenbachia

L. Ferns

M. Ficus

N. Palms

O. Pepperomia

V. Methods of Plant Growth Regulation (See Unit 3 & 4).

A. Chemical - B-Nine, Cycocel, gibberellin

B. Mechanical - pruning, pinching, disbudding.

VI. Means of Controlling Pests and Diseases in a Greenhouse.

A. Biological - resistant varieties, predators.

B. Chemical - sprays, granules, smoke, fog.

C. Mechanical - hand picking, pruning, hoeing.

GREENHOUSE

UNIT 1

ASSIGNMENT SHEET #1: Planning Pot Mum Production

I. Materials:

1. Sufficient copies of pot mum crop schedules for your locality. These are available from the suppliers of your cuttings.
2. Bench space allocated to each student.

II. Procedure:

1. Select cultivars.
2. Each student is to work out a production plan for pot mums for the designated amount of bench space for one year. Plan must include: planting, pinching, growth regulation application, disbudding, lighting, shading and marketing dates.
3. Plan must also include: fertilization and spray requirements as well as changing space requirement.
4. This project may take the form of a large write-in calendar.

GREENHOUSE
UNIT 1

JOB SHEET #1: Pot Mum Production

I. Materials:

1. 12 - 18 inch cuttings (rooted).
2. Ingredients for mixing and blending growing media.
3. Appropriate jobs as per pot mum production schedule (Assignment Sheet #1) will be carried out for the designated time (approx. 10-13 weeks).
4. Plants may be divided into different groups with different treatments given each group to compare results.

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GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #1: Geranium

1. Sales Period - Mother's Day (mid-May), Memorial Day (end of May), also through June.
2. Propagation - Seed, mid-January, 70°F bottom heat; rooted cuttings potted March 1. "Cultured" cuttings highly recommended.
3. Pot Size - 4", 3", some in packs
4. Soil - Porous, not too high in organic matter; steamed.
5. Light Intensity - full sun, light shade in May.
6. Temperature - 60°F for growing; 55°F for holding.
7. Nutrition - 15-15-15 in irrigation water at 75 ppm N rate; high N gives poor flowering and heavy foliage; low K give brown leaf margins
8. pH - 6.0 - 7.0
9. Soluble Salts - below 80 "K"
10. Watering - may be allowed to wilt slightly between waterings.
11. Pests - White flies, two-spotted mites.
12. Diseases - Pythium rot, bacterial stem rot, Vericillium wilt, Botrytis blight, viruses, odema.
13. References:
    - a. The Penn State Geranium Manual, 1970.
    - b. 1967 Cornell Recommendations Floriculture Crops.

GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #2: Rose

1. Sales Period - Valentine's Day, Easter, Mother's Day, Memorial Day.
2. Propagation - purchase forcing size, dormant plants; ordered one year in advance; pot upon receipt, water, and hold at 35°F to 40°F until forcing time.
3. Pot Size - 7", standard for sweetheart type, 4", standard for miniature type
4. Soil - standard mixture, well drained.
5. Nutrition - 20-20-20 in irrigation water at 150 ppm N rate; or soluble at 2-week intervals.
6. pH - 6.0 - 7.0
7. Forcing Schedule - (1970 example, adjust for future years, see Appendices)

Condition	Valentine's Day	Easter	Mother's Day	Memorial Day
Start at 50°F	11-4	1-5	2-20	3-15
Raise to 55°F	12-1	1-25	3-13	4-5
Raise to 60°F	12-15	2-6	3-27	4-19
Buds visible	1-3	2-17	4-9	5-9
Buds in color	2-1	3-17	4-30	5-26
In bloom	2-14	3-29	5-10	5-30

8. Watering - do not allow to wilt
9. Pests - aphids, two-spotted mites, thrips
10. Diseases - powdery mildew, black spot
11. Recommended cultivars:
    a. Sweetheart Type: Bright Pink Garnette, Carol Amling, Dick Koster, Garnette, Orange Rumba, Margo Koster, Mother's Day, Pink Marvel, Scarlet Marvel, Skylark, Summer Snow, Thunderbird, Triumphe d'Orleans.
    b. Miniature Type: Baby Gold Star, Bo-Peep, Chipper, Cinderella, Eleanor, Midget, Pixie, Pixie Gold, Pixie Rose, Red Imp, Scarlet Gem, Starina.
12. References:
    a. Commercial Flower Forcing, Seventh Ed.
    b. Roses Manual.

GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #3: Azalea

1. Sales Period - Christmas, Valentine's Day, Easter, Mother's Day, (a few year around.)
2. Propagation - purchase dormant, budded, precooled, plants for forcing (for culture to this stage see reference)
3. Pot Size - 4", 5", 6" "azalea" pots; the same size in which shipped.
4. Soil - coarse peat
5. Forcing Schedule - (1970 example, adjust for future years, see Appendices A&B)

Group	(1969) Thanksgiving		Christmas		(1970) Valentine's Day		Easter		Mother's Day
	A	B	A	B	A&B	C	AB&C	D	ABC&D
Start at 50°F	10-31	10-16	11-28	11-14	1-17	1-3	3-17	3-1	5-3
60°F-65°F	11-7	10-23	12-2	11-21	1-27	1-10	3-24	3-8	
Buds show color	11-22	11-22	12-18	12-18	2-7	2-7	3-25	3-25	
In bloom	11-27	11-27	12-25	12-25	2-14	2-14	3-29	3-29	5-10

6. Fertilizing: None
7. Forcing Groups:
   a. Coral Bells, Coral Bells Supreme
   b. Ambrosier, Alaska, Albion, Alice Mueller, Apricot Queen, Chimes, Chimes Sport, Constance, Delight, Dorothy Gish, Dr. Bergman, Early Wonder, Eclaireur, Eric Schame, Gloria, Firelight, Hexe, L.C. Bobbink, Mme. Petrick, Orange Kind, Paul Schame, Perle de Swenaarde, Pink Ruffles, Pocahontas, Purity, Red Cap, Red Wings, Rhapsody, Rose Queen, Salmon Glow, Snow, Snowbank, Snow Queen, Sunset, Triumphe, Vervaeneana, Westwood Red.
   c. Albert and Elizabeth, Empress of India, Glory of Easter, Jean Haerens, Knute Erwin, Mrs. Fred Sanders, Sweetheart Supreme.
   d. Baby Pericat, Easter Parade, Marjory Ann, Mme. Pericat, Pericat, Pink Pericat, Rose Pericat, Sun Valley.
8. Post-Cooling - Advanced plants can be held in unlighted 35°F storage at the "bud color" stage for 2-4 weeks.
9. Reference:
   a. Commercial Flower Forcing, 7th Ed.

GREENHOUSE
UNIT 1
SUPPLEMENTAL SHEET #4: Hydrangea

1. Sales Period - Easter, Mother's Day
2. Propagation - purchase forcing size, dormant, precooled plants for forcing (for culture to this stage, see reference)
3. Pot Size - plant in next larger size than received - usually into 6" standard
4. Soil - standard mixture; pH 6.5 for pink and white blooms, 5.0 for blue.
5. Nutrition - 20-20-20 in irrigation system at 200 ppm N rate.
6. Forcing Schedule - (1970 example - adjust for future years, see Appendices A and B)

Date	Development
December 2	remove from cold storage and place at 50°F
December 23	55°F buds swelling
January 2	leaves unfolding
January 6	60°F, 2 - 4 leaves showing
January 10	6 leaves
January 15	8-10 leaves
January 21	flower head just visible
January 27	flower head dime size
February 3	flower head nickel size
February 9	flower head quarter size
February 16	flower head half-dollar size
March 2	bracts developing
March 5	bracts expanded
March 11	bracts coloring
March 16	bracts colored and hardening
March 25	harden at 50°F
March 29	Easter

120-day schedule for Strafford, Merveille, and Engle's White; 10 days longer for Rose Supreme

7. Reference:
   a. Commercial Flower Forcing, 7th Ed.

GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #5: African Violet

1. Sales Period - mid-September through December; many sold year-around
2. Propagation - leaf petiole cuttings stuck 9 months before crop desired; air 65°F, medium 70°F; can be done under fluorescent lamps.
3. Pot Size - 2-1/2" from propagation bench; shifted to 3" or 4" "azalea" in 4th month.
4. Soil - 2 peat, 1 loam, 1 sand; pH 6.0 - 7.0.
5. Light Intensity - 1500 fc. maximum; no shade in December, heavy shade on glass, plus muslin under glass in June.
6. Temperature - 65°F
7. Nutrition - 10-30-30 in the irrigation water at 100 ppm N rate; or soluble every 14 days.
8. Watering - must be kept moist at all times (wilt only under severe stress), water must be within 20°F of leaf temperature or cream blotches of killed chlorophyll will appear on foliage.
9. Pests - cyclamen mites
10. Diseases - crown rot, powdery mildew, leaf spot, nematodes.
11. Handling, Packing, Shipping - leaves are very brittle, plants are often allowed to wilt slightly to soften leaves so there is less breakage; must be well insulated in cold weather.
12. Cultivars - Hundreds in the trade, new ones each year; customers want to buy labeled plants, so individual pots must be labeled with the cultivars; care cards are a good idea.
13. Reference:
    a. Commercial Flower Forcing, 7th Ed.

GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #6: Foliage Plants

1. Sales Period - year-round, with the highest volume in fall
2. Kinds - several hundred cultivars of foliage plants for indoor use are commonly grown commercially.
3. Propagation - most producers in the northeast United States purchase rooted cuttings or small plants for growing to salable size. Southern propagators use stem, leaf, or leaf-petiole cuttings or seed.
4. Pot Size - varies with the kind and size of plant; "dish gardens" of mixed planting are often marketed.
5. Soil - usually peat; some use 2 peat, 1 loam, 1 inert material.
6. Light Intensity - 2000 fc. maximum from April 1 to October 15
7. Temperature - 65^{o}F to 70^{o}F for growing; 60^{o}F to 65^{o}F for holding; 75^{o}F to 80^{o}F for propagation.
8. Nutrition - "constant feed" in irrigation water using 20-20-20 at 75 to 100 ppm N rate.
9. pH - 5.5 to 6.5
10. Soluble Salts - below 80 "K"
11. Watering - except for cacti, intolerant of drying
12. Pests and Diseases - aphids, mealybugs, two-spotted mites, scales, root rots
13. References:
    a. Exotica III.

GREENHOUSE

UNIT 1

SUPPLEMENTAL SHEET #7: Spring-Flowering Bulbs

1. Sales Period - Easter, but some sold February through April.
2. Kinds - certain cultivars are superior to others for early, mid-season and late forcing. Appropriate ones should be ordered one year in advance of planting time.
3. Pot Size - tulips - 5-inch, 3/4 pot; 6 bulbs.

   hyacinths - 5-inch, 3/4 pot, 4 bulbs; or 3-1/2-inch pot, 1 bulb

   daffodils - 6-inch pot, 4 DN (double nose) bulbs
4. Soil - well drained, porous, Bulb tops should protrude slightly.
5. Light - a light shade is needed for the first 2-3 days of forcing
6. Insects and Diseases - botrytis, leaf aphids, bulb aphids
7. Forcing Program Example - Easter 1970 (March 24)

Crop	Pot	Rooting Temperature	Start Forcing	Sell
Tulip	Nov. 15-30	3 wks. 48°F 4 wks. 41°F then 35°F	March 12 at 65°-68°F	March 24, 1970
Hyacinth	Nov. 15-Dec. 7	3 wks. 48°F then 35°F	March 12 at 65°-68°F	March 24, 1970
Daffodils	Nov. 15-Dec. 1	3 wks. 48°F 4-5 wks. 41°F then 35°F	March 6 at 60°F	March 24, 1970

8. References:
   a. Using a Bulb Cellar
   b. Bulb Forcer's Handbook

GREENHOUSE

UNIT 1

TEST

1. Match the following terms with their definitions.

______a. Dormant

______b. Bracts

______c. Stock Plant

______d. Class

______e. Cultivar

______f. Influorescent

1. A plant used as a source of cuttings.
2. A cluster of flowers.
3. Not in the active stage of growth.
4. A subgroup of a plant species, having similar shaped and sized flowers.
5. Brightly colored leaf-like organs surrounding the true flowers.
6. Cutlivated plants that can be reproduced to give identical plants usually given a name, a variety.

2. Name two categories of pot plant production operations.

3. Select from a list those items which are required for producing pot plants.

_____a. Potting and shipping areas must be on opposite ends of the greenhouse range.

_____b. Correct watering schedules according to the needs of the plant are necessary.

_____c. Correct fertilization program according to soil test is needed.

_____d. Unlimited availability of growing media is a must.

_____e. Pest control procedures are non-productive.

_____f. Benches should be over 80" wide.

_____g. Production schedules are necessary with flowering plants.

4. Select the common pot plants and mark an "X" in front of each correct one.

_____a. Philodendron

_____b. Snapdragon

_____c. Mums

_____d. Carnation

_____e. Hybrid tea roses

_____f. Azaleas

_____g. Pothos

_____h. Straw flowers

_____i. Lilies

_____j. Gladiolus

TEST

_____k. Poinsettia

_____l. Ferns

_____m. Flowering dogwood

_____n. African Violet

_____o. Algae

_____p. Cacti

_____q. Ficus

_____r. Bamboo

5. List two methods of plant growth regulation.

6. List three means of controlling pests and diseases in the greenhouse and give examples of each.

GREENHOUSE

UNIT 2

CUT FLOWER PRODUCTION

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to list the concepts of producing cut flower crops. In addition the student will be able to plan a cropping schedule and develop the plan into actual cropping practice. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms and definitions concerning cut flower production.
2. List two reasons for the demand for cut flowers.
3. List six general cropping requirements of cut flowers.
4. State two general fertilizer recommendations when producing cut flowers.
5. State three items to consider when developing a crop rotation schedule.
6. Name four factors in harvesting and packing cut flower crops.
7. Develop a one year cut flower schedule. (Assignment Sheet #1)
8. Grow at least one cut flower crop. (Job Sheet #1)

GREENHOUSE

UNIT 2

INFORMATION SHEET

I. Terms and Definitions.

A. Bacteria - disease producing microorganisms belonging to animal kingdom.

B. Bench - a raised table-like area where plants are placed for growing

C. Fungi - microscopic disease producing plants

D. Lateral buds - buds on the side of the stem

E. Terminal bud - The bud at the top of the stem

F. Bunched - things of the same kind that are grouped together

G. Grids - a framework of metal bars or wires

H. Reset - a plant that is transplanted.

I. Shoots - new growth in plants (See TM 1)

J. Sport - a change in color or shape of a plant part, that can be reproduced vegetatively.

K. Terminal cutting - cuttings at the end or top of a stem or branch.(See TM 1)

L. Standard - any large-flowered type, all lateral flower buds removed especially mums. (See TM 2)

M. Disbud - any spray-type grown with all lateral flower buds removed (see TM 2)

N. Disspray - any spray-type with the central flower bud removed (See TM 2)

O. Spray - any branching type grown without removal of any flower buds.

II. Reasons for Demand for Cut Flowers.

A. Appropriate the year around.

B. Special appeal for any occasion.

C. Universal usage for cut flowers in arrangements, etc.

III. General Cropping Requirements.

A. Benches low and narrow (3½' - 4'wide)

B. Soil texture rather coarse for drainage.

C. Organic matter needs to be added for each crop.

D. Top of soil should be 1" lower than edge of bench

E. Enough water needs to be applied so water drains through the bench

F. Correct temperatures need to be maintained

G. Plants need a constant supply of fertilizer

INFORMATION SHEET

IV. General Fertilizer Recommendations.

A. Fertilizer can be added in dry form but is difficult to apply uniformly.

B. Soil must be moist if dry fertilizer is used.

C. Fertilizer application needs are determined by

1. How porous the soil is.
2. How heavily plants are watered.
3. How often plants are watered.
4. Size of plants.

D. Soil test regularly (once per month).

V. Crop Rotation Scheduling.

A. Rotation must be accurately planned for steady supply of flowers

B. While harvesting, inventories and plans for changes in cropping procedures must be made

C. Once a crop is planted it may be one year before harvesting the crop.

VI. Factors in Harvesting and Packing.

A. Flowers should be harvested in the morning.

B. Grade, bunch, place flowers in vases, and refrigerate as soon after harvesting as possible.

C. Generally place 25 flowers of the same quality of a variety per bunch.

D. Culls should be discarded or bunched and sold as utility flowers.

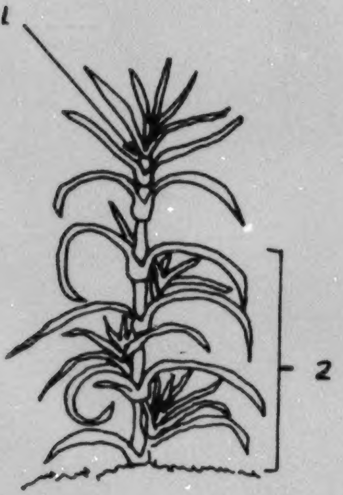
E. Each species has its own unique requirements for packing and shipping correctly.

GREENHOUSE

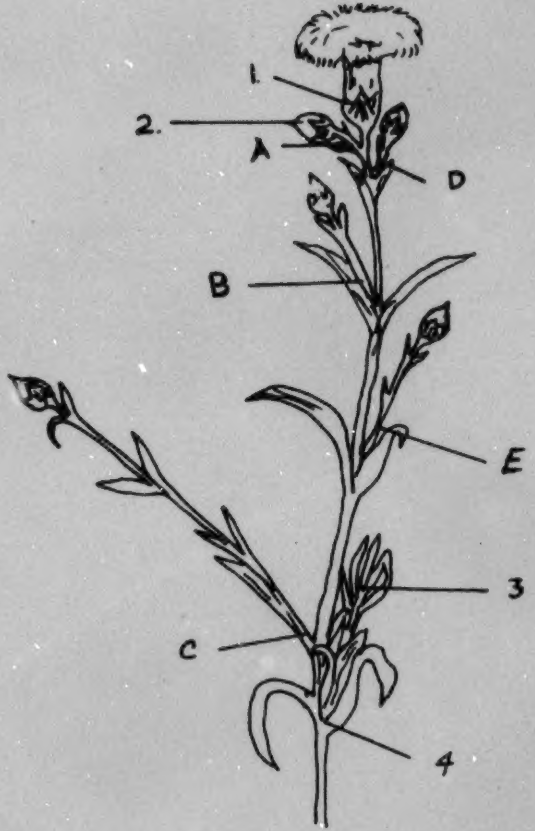
UNIT 2

ASSIGNMENT SHEET #1: Developing Rotation Schedule for Carnations.

Develop a one year production schedule for a cut carnation crop. Include as many recommendations and procedures as possible such as a calendar of production, planting recommendations, watering needs, fertilizer recommendations, temperature requirements, times to pinch and disbud, harvesting packing and shipping recommendations.



1. Terminal Cutting
2. Shoots



1. Mature flower
2. Flower bud - lateral
3. Shoot
4. Eighth node - cut flower above this node

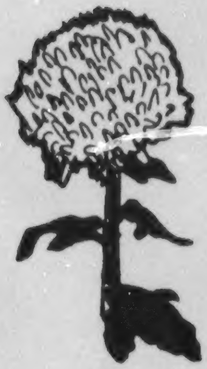
A, B, C, D, E - These buds should be removed

GREENHOUSE

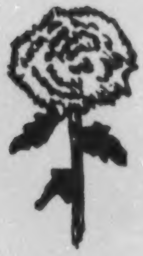
UNIT 2

JOB SHEET #1: Producing Carnations.

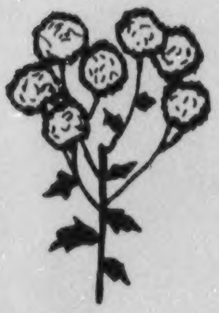
Using the schedule developed in Assignment Sheet #1, produce at least one crop of carnations for cut flowers.



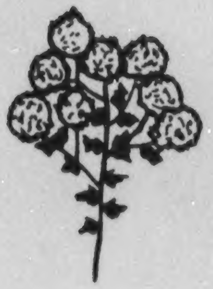
Standard



Disbud



Disspray



Spray

GREENHOUSE

UNIT 2

SUPPLEMENTAL SHEET #1: Roses

1. Sales Period - peaks at Christmas, Valentine's Day, Easter, and Mother's Day, but sold throughout year.
2. Propagation - dormant Hybrid Tea and/or Sweetheart plants ordered one year in advance of planting in late spring at 12 x 12 inch spacing, replanted every 4 years.
3. Soil - same as for chrysanthemums
4. Fertilizing - same as for chrysanthemums
5. Light - intensity as high as possible with temperature control
6. Temperature - 58°F to 62°F night, depending upon cultivar; washed air cooling essential in summer
7. Carbon Dioxide - 1500 ppm gives high production and good quality
8. Timing - pinching pea-size buds 8 weeks before Christmas, 8 weeks before Valentine's Day, 7 or 6 weeks before Easter, 5 weeks before Mother's Day
9. Pests - two-spotted mites, aphid, thrips, mildew, nematodes
10. Harvesting - cut in morning and in afternoon; when sepals curl or first petal opens; in fall and winter leave stub with two 5-leaflet leaves, in spring and summer cut to a "hook"; refrigerate quickly in water with flower preservative; may be held dry at 31°F as for carnations
11. Grading - according to 3-inch stem length increments; 13 or 25 roses are spirally wrapped in a sheet of paper to make a bunch
12. References:
    a. Commercial Flower Forcing, 7th Edition. Laurie, Alex Kiplinger, D.C. and Nelson, Kennard, McGraw-Hill Book Company, New York, New York, 1968.
    b. Roses. Mastalerz, John W. (Ed.) Agricultural Extension Service, The Pennsylvania State University, Published by The Pennsylvania Flower Growers, 1970.
13. Audio-Visual Aid - "What's Behind a Rose" (18 min., sound, color, motion picture).

GREENHOUSE

UNIT 2

SUPPLEMENTAL SHEET #2: Orchids

1. Sales Period - Christmas, Valentine's Day, Easter, Mother's Day, some throughout the year; cymbidiums, December through May
2. Propagation - seed sown on sterile nutrient agar by specialists
3. Containers - 6-inch standard clay pot
4. Mediums - cattleyas - fir bark and osmunda fiber; cymbidiums - fir bark and redwood fiber
5. Light intensity - cattleyas - under 2000 fc., shade April 1 to October 15 cymbidiums - full sunlight, light shade in flower
6. Photoperiod - certain cattleya cultivars respond
7. Temperature - cattleyas, 55° to 65°F nights, depending upon cultivar and stage of flower buds; cymbidiums initiate and develop flower buds only below 65°F
8. Carbon Dioxide - 1500 ppm for cymbidiums increases number of blooms
9. Nutrition - 18-18-18 in irrigation water at a 100 ppm N rate
10. Relative Humidity - 60 to 80% RH
11. Pests - orchid weevil, slugs, snails, scales, leaf spots, virus
12. Harvesting - flowers must "harden" on the plants for 3 days after opening, cut and placed individually in water tubes, refrigerated at 50°F, shipped tied into bottom of boxes to prevent movement
13. Cultivars - hundreds are grown
14. References:
    a. Commercial Flower Forcing, 7th Edition. Laurie, Alex, Kiplinger, D.C., and Nelson, Kennard, McGraw-Hill Book Company, New York, New York, 1968.

GREENHOUSE
UNIT 2
TEST

1. Match the following terms with their definitions.

_____a. Sport
_____b. Bench
_____c. Grids
_____d. Spray
_____e. Bunched
_____f. Fungi
_____g. Bacteria
_____h. Disspray
_____i. Shoots
_____j. Lateral buds
_____k. Standard
_____l. Terminal bud
_____m. Reset
_____n. Disbud
_____o. Terminal cuttings

1. Microscopic disease producing plants
2. Any branching type grown without removal of any flower buds.
3. A framework of metal bars or wires
4. New growth in plants
5. Cuttings at the end or top of a stem or branch.
6. Disease producing microorganisms belonging to the animal kingdom
7. Buds on the side of the stem
8. A plant that is transplanted
9. Any spray type with the central flower bud removed.
10. A change in color or shape of a plant part, that can be reproduced vegetatively.
11. Things of the same kind that are grouped together.
12. Any large flowered type, all lateral buds removed, especially mums.
13. A raised table-like area where plants are placed for growing.
14. The bud at the top of the stem.
15. Any spray-type grown with all lateral flower buds removed.

2. List two reasons for the demand for cut flowers.

3. List six general cropping requirements for cut flowers.

4. State two general fertilizer recommendations when producing cut flowers.

5. State three items to consider when developing a cut crop rotation schedule.

6. Name four factors in harvesting and packing cut flower crops.

7. Complete Assignment Sheet #1.

8. Complete Job Sheet #1.

PLANT PROBLEMS AND CONTROLS

UNIT 1

PRINCIPLES OF DISEASE CONTROL

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to define terms pertaining to the principles of disease control; to list methods of disease controls that include legal, cultural, physical, chemical, biological, and their problems; and to identify information concerning the physiological and genetic alteration of the plants. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that relate to disease controls.
2. List at least five methods of disease controls.
3. Name two kinds of studies that pertain to controlling plant diseases.
4. Name two legal controls for controlling plant disease.
5. Name four cultural controls for controlling plant disease.
6. Identify which of given statements about physical controls are true and which are false.
7. Identify as true or false given statements about chemical controls.
8. List at least three problems of chemical controls.
9. Identify as true or false given statements about biological controls.
10. Identify as true or false given statements about the physiological alteration of plants.
11. Identify as true or false given statements about the genetic alteration of plants.

PLANT PROBLEMS AND CONTROLS

UNIT 1

INFORMATION SHEET

Terms and Definitions

1. Pathogen - Any disease producing bacterium or microorganism.
2. Pesticide - Generic name for all chemicals that control plant pests (toxic to some stage of the plant pest life cycle).
3. Fungicide - Generic name for all chemicals that control fungi.
4. Predator - An animal constituted for living by preying upon others.
5. Host - A plant that is attacked by a disease.
6. Alternate host - A plant that carries and complete life cycle of some diseases, without being destroyed by them.
7. Roguing - Eliminating inferior or diseased plants or seeds, undergoing selection

Methods of Disease Control

1. Study of pathogenic plant disease
2. Legal controls
3. Cultural controls
4. Physical controls
5. Chemical controls
6. Biological controls
7. Growing resistant plant varieties

Kinds of Pathogenic Plant Disease Study (TM #1):

1. Plant pathology - Deals with fungal, bacterial, or viral origin of plant diseases.
2. Entomology - The study of insects.

NOTE: Both pathologists and entomologists study menatodes

Legal Control of Plant Diseases

1. Quarantines - Prohibits the importation or shipping of certain plants, which may effectively eliminate or slow down the introduction of new pests.
2. Inspections - Plant shipments are inspected to prevent the spread of some pests.

Cultural Control of Plant Diseases

1. Roguing - Eliminating diseased plants or seeds.
2. Surgery - Removal of infected parts of a plant.
3. Sanitation - Removal of plant debris

INFORMATION SHEET

4. Rotation - Alternate plants
5. Elimination of Alternate Host - Example: Cedar-Apple Rust.
6. Planting Resistant Varieties.

Physical Control of Plant Diseases and Plant Problems

1. Physical barriers - Guards (such as fencing) to protect tree trunks, shrubbery, crops from rodents, rabbits, mice, and other animals.
2. Immersion in hot water (110°- 122° F for 5-25 minutes) - Used as a treatment for destroying pathogens that infest seeds and bulbs for control of some fungal diseases of grain; of some bacterial disease; for some nematode control.
3. Syringing - Action of a strong stream of water that reduces the infestation of spider mites, aphids, etc.
4. Attractants - Lures that attract pests into a trap where they are killed.

Chemical Control of Plant Diseases (See Unit 2)

1. Practically all the horticultural industry relies on complete schedules and a variety of compounds of chemical application for growing crops.
2. The agricultural chemical industry is a vigorous one; new materials are continually being released.

Some Problems of Chemical Control

1. Residues on edible products may be toxic.
2. Application has technical problems (timing, compatability of different pesticides, and thoroughness of application).
3. The pathogen may develop genetic resistance.
4. Biological balance can be disturbed.
5. Plants can be injured by chemicals.
6. Soil and water can become polluted.

Biological Control of Plant Disease

1. Utilizes direct competition between organisms.
    a. Certain insects feed on other insects.
    b. There are virus diseases of bacteria.
    c. There are bacterial diseases of insects.
2. Introduces natural parasite or predator to the pathogen.
3. Requires an organized attack on the pathogen - example: only one grower using lady bugs as a predator is not too effective: all growers in the area must comply.

INFORMATION SHEET

4. Once put into effect, biological controls need very little attention from man.

Physiological Alteration of the Host

1. Most plants, unlike animals, do not have an antibody mechanism to resist disease; thus such plants cannot be made immune by vaccines.
2. Plants can be altered, however, to resist or overcome the detrimental effects of the pathogen. Example: Many vascular wilts caused by fungus (Verticullum albo agrum) can be overcome by application of fertilizer to increase vigor, causing the plant literally to outgrow the pathogen. Reverse technique is used in fireblight of pears - by eliminating excessive nitrogen fertilization or by severe pruning - the plant survives and literally starves the pathogen.

Genetic Alteration of the Host

1. Genetic resistance (immunity) varies from susceptibility to complete resistance.
2. Susceptibility is the lack of resistance.
3. Tolerance is a type of resistance in which plants suffer infection and some injory but are able to survive.
4. The plant's resistance is determined by its structure and biochemical makeup at any point in time to the degree that it either prevents or discourages entry and persistence of a particular pathogen.
5. Some plants have resistance to whole groups of pathogens.
6. Other plants have resistance only to a particular species or race of pathogens.
7. When plant and pathogen have a close relationship, the plant evolves a genetic resistance and the pathogen evolves the genetic ability for overcoming this resistance.
8. The spontaneous origin of new races of pathogen is one of the major problems the plant breeder faces in attempting to develop genetic resistance into an improvement program.
9. Resistance may be incorporated in the whole plant or in only the grafted parts of the plant.

Resistant Varieties of Certain Crops

CROP	VARIETY	RESISTANT TO:
Pear	Baldwin, Pontotoc	Fireblight
Peach	Shalil, Yunan	Nematode (certain strains)
Potato	Katahdin, Kennebec	Mild mosaic
Onion	White Persian	Thrips
Squash	African	Vine borer
Tomato	Pan American	Fusarium wilt
China aster	Tilford	Fusarium wilt
Gardenia thenbergii		Nematode
Snapdragon	Outdoor varieties	Rust

PLANT PROBLEMS AND CONTROLS

UNIT 1

TEST

1. Match the following terms and definitions:

_____a. Fungicide

_____b. Pesticide

_____c. Pathogen

_____d. Alternate Host

_____e. Predator

_____f. Roguing

_____g. Host

1, Constituted for living by preying upon others.

2. To eliminate inferior plants undergoing selection.

3. Generic name for all chemicals that control drugs.

4. A large family of annual or perennial herbs.

5. Any disease-producing bacterium or microorganism.

6. Generic name for all chemicals that control plant pests (toxic to some stage of the pest life cycle).

7. A plant that carries and completes life cycle of some diseases, without being destroyed by them.

8. A plant that is attacked by a disease.

2. List at least five methods of disease control.

3. Name two kinds of studies that pertain to controlling plant diseases.

4. Name two legal controls for controlling plant diseases.

5. Name six cultural controls for controlling plant diseases.

6. Indicate which of the following statements are True and which are False:

_____a. Immersion in hot water is used as a treatment for destroying pathogens.

_____b. Physical guards such as fencing are erected to protect plants from mice, rodents, and rabbits.

_____c. Syringing, the action of a strong stream of water, does not reduce the infestation of aphids.

_____d. Attractants lure pests into a trap.

7. Identify which of the following statements are True and which are False:

_____a. Practically all the horticultural industry rely on chemicals for growing crops.

_____b. No new chemical controls are being developed at this time.

_____c. The chemical industry is a vigorous one.

TEST

8. List at least three problems of chemical controls.

9. Identify as True or False each of the following statements concerning biological controls for controlling plant diseases.

_____a. Utilizes direct competition between organisms.

_____b. Introduces natural parasite or predator to the pathogen.

_____c. Requires no organized attack on the pathogen by growers.

_____d. Once put into effect needs very little attention from man.

10. Identify as True or False each of the following statements:

_____a. Plants do not have an antibody mechanism to resist disease.

_____b. Plants can be altered to resist or overcome the detrimental effects of the pathogen.

11. Identify as True or False each of the following statements concerning the genetic alteration of the host.

_____a. Genetic resistance (immunity) varies from susceptibility to complete resistance.

_____b. Plants cannot be changed.

_____c. Susceptibility is the lack of resistance.

_____d. Tolerance is a type of resistance in which plants suffer infection and some injury but are able to survive.

_____e. The plant's resistance is determined by its structure and biochemical makeup at any point in time to the degree that it either prevents or discourages entry and persistence of the particular pathogen.

_____f. Some plants have resistance to whole groups of pathogens.

_____g. Other plants have only a specific resistance to particular species, or race of pathogen.

_____h. When a plant and pathogen have a close relationship, the plant evolves the genetic ability for overcoming this resistance.

_____i. The spontaneous origin of new races of the pathogen does not bother the grower and breeder.

_____j. Resistance cannot be incorporated in the grafted parts of the plant.

PLANT PROBLEMS AND CONTROLS

UNIT 2

PESTICIDES AND SAFETY

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms pertaining to pesticides and safety; to classify chemical compounds according their toxic effects upon pests; to describe how to select, handle, mix, and dispose of pesticides; to select the proper application equipment; and to store surplus pesticides properly. This objective will be considered achieved upon the attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match definitions with terms that relate to pesticides and safety.
2. List at least five chemical compounds classified according to their toxic effect.
3. Identify as true or false given statements concerning stomach-and-contact poisons.
4. Identify as true or false given statements concerning contact poisons.
5. Identify as true or false given statements concerning systemic poisons.
6. Identify as true or false given statements concerning fumigants.
7. Identify as true or false given statements concerning seed and seed-stock treatment materials.
8. Identify as true or false given statements concerning fungicides and/or bactericides.
9. Identify as true or false given statements concerning antibiotics.
10. Name at least four factors to consider when selecting a pesticide.
11. Name at least five factors to consider when handling and mixing pesticides.
12. Identify as true or false given statements concerning applying pesticides.
13. List three ways to dispose of surplus pesticides and containers.
14. Identify as true or false given statements concerning proper methods of storing pesticides.
15. List at least five kinds of pesticide application equipment.

PLANT PROBLEMS AND CONTROLS

UNIT 2

INFORMATION SHEET

I. Terms and Definitions:

   A. Pesticide - Generic name for all chemicals that kill plant pests at some stage of their life cycles.

   B. Fungicide - Generic name for all chemicals that kill fungi.

   C. Spore - A single cell which, when freed, develops into a new plant or animal.

   D. Translocation - The movement or conduction of water soluble organic materials and minerals from one part of the plant to another.

   E. Systemic action - Translocation of a pesticide from one part of a plant to another, affecting the toxic action throughout the plant's system.

   F. Toxic - Poisonous

   G. Mycelium - Vegetative portion of a fungus

   H. Colloid - A substance in a state between being a solution and in suspension.

   I. Nematode - A very small roundworm which lives in the soil and frequently enters the plants through the roots.

   J. Herbicide - A chemical substance used to kill herbaceous plants.

   K. Antidote - A substance used to counteract the affect of poisons.

II. Chemical Compounds Classified According to Toxic Effect

   A. Stomach-and-contact poisons (insecticides - kill either by affecting stomach or by contact).

   B. Contact poisons (insecticides - kill by contact only).

   C. Systemics (kill by entering plant, and exerting control in plant conducting system).

   D. Fumigants (gasses that kill by stopping respiration of insects and nematodes).

   E. Seed and seed-stock treatment materials (applied to seeds, tubers, bulbs and fleshy roots; kill fungi or bacteria cells).

   F. Fungicides and Bactericides (applied to plant surface to inhibit growth of spores, fungi or bacteria cells).

   G. Antibiotics (applied in solution; kill fungi).

   H. Herbicides (will be discussed in Unit 5 of this Block).

III. Facts About Stomach-and Contact Poisons

   A. Used for the control of insects with either chewing or sucking or rasping mouth parts.

INFORMATION SHEET

B. Some poisons are rotenone, chlordane, dieldrin, lindane, malathion, methoxychlor, parathion, and pyrethrum products.

C. Pyrethrum products are nonpoisonous to man but expensive.

IV. Facts About Contact Poisons

A. Used to control insects with sucking or rasping mouth parts.

B. Poison penetrates through the insect body directly or through the breathing or sensory pores.

C. Some poisons and how used: nicotine sulfate for the control of many kinds of aphids; aramite for the control of phosphate-resistant red spider mites; and oil emulsions for the control of scale and mealybugs.

V. Facts About Systemic Poisons

A. Chemical compounds which enter the conducting systems of plants.

B. They may be applied as a foliage spray or to the soil.

C. Most effective against insects with sucking or rasping mouth parts.

D. Since systemics are highly poisonous to man, their use is usually limited to nonedible crops such as cotton and crops grown for their flowers.

E. Some examples of systemics are Demeton and OMPA or Pestox-3.

F. Nonsystemic - main action is to coat the plant, some of the chemicals are absorbed by the plant nevertheless.

VI. Facts About Fumigants

A. Chemical compounds which change from either the solid or liquid form to the vapor or gaseous form.

B. These gases stop the respiration of insects and nematodes and enter the cells of fungi and bacteria.

C. They can be applied to the soil or to crops growing in greenhouses or similar structures.

D. Chemicals applied to the soil are chloropicrin, methyl bromide, Nemagon, Vapam, and VC-13.

E. Chemicals applied to crops inside enclosures are aerosols of dithio compounds, parathion, malathion, and TEPP.

VII. Facts About Seed and Seed-stock Treatment Materials

A. Chemical compounds which are applied to the surface of seeds, tubers, bulbs, and fleshy roots.

B. Used to protect young plants against certain types of fungi of bacteria which would otherwise damage or destroy them.

INFORMATION SHEET

C. Applied in carefully measured doses which kill the cells of bacterium or fungus and at the same time do no damage to the seedling plants.

D. Some examples of the chemicals are mercuric chloride, Captan, Chloronil, Diclone, and Thiram.

VIII. Facts About Fungicides and/or Bactericides

A. Chemical compounds used to prevent or inhibit the growth of germinating spores, mycelium of fungi, or the cells of certain bacteria on the surface of the plant.

B. Once these organisms have successfully invaded the tissues, the use of these compounds is not effective. Timing of the application is essential.

C. Application to outdoor crops should be made just before, rather than after, a rain.

D. Some examples are copper sulfate and fresh hydrated lime in a suspension with water, commonly called Bordeaux mixture; quick lime and sulfur in solution with water; colloidal (or wettable) sulfur; sulfur dust; and the dithiocarbamates - Dithane, Fermate, Manate, Parxate, Captan, Mildex, and Cyprex.

IX. Facts About Antibiotics

A. Antibiotics are definite chemical compounds which are made by a given organism for its protection against disease-producing organism.

B. For example: The fungus Penicillium-notatum makes and secretes the antibiotic penicillin for protection against its bacterial enemies. In other words, the penicillin kills the invading bacteria.

C. Experiments by plant scientists have shown that antibiotics are effective against certain diseases caused by fungi.

D. They are systemic in action.

E. They are applied in a solution of water and are absorbed into the plant sap.

F. Examples of antibiotics used to control certain plant disease are streptomycin, streptomycin-terramycin, and Actidone.

X. Factors to Consider When Selecting Pesticides

A. Identify the pest to be controlled. If in doubt, consult County Extension Agent or other agricultural agencies.

B. Be certain the pesticide is recommended by a competent authority for the particular problem.

C. The pesticide lable will contain the name of the pest to be controlled and the crop, animal, or place of intended use.

D. Determine the active ingredients and the proper mixing and application procedures.

INFORMATION SHEET

E. Follow and heed all warnings and cautions.

F. Since pesticide labeling sometimes changes, be sure the pesticide label is up to date.

G. The use of persistent pesticides may limit the crops which can be grown in that soil the following season.

H. Purchase only amounts needed for a single season to reduce storage and possible disposal problems.

XI. Factors to Consider When Handling and Mixing Pesticides

FOR SAFETY'S SAKE

A. Read label directions and current recommendations carefully before mixing. Note all warnings and cautions before opening container.

B. Wear suitable protective clothing and equipment as specified on the label.

C. Open pesticide containers carefully to avoid dust or splashing.

D. Measure accurately, using proper equipment. Do not use containers or measuring tools used for food, beverage, feed, or seed.

E. Pesticides should be handled in a well-ventilated area, preparing no more than will be used in one day.

F. Watch out for wind! When pouring or mixing, avoid having dust or splashback blown in face or on your body.

G. Don't mix pesticides near wells, streams, or ponds where there is a chance that spills or overflows will get into water supply.

H. Clean up spills immediately. Wash pesticide off skin promptly with plenty of water and soap. Change clothes if pesticides are spilled on clothing.

I. Avoid working with pesticides alone. Call your doctor if there is any doubt about your contact with the pesticide.

NOTE: Highly toxic insecticides like TEPP, Demeton (Systox), Endrin, Parathion, Mevinphos (Phosdrin), Phorate (Thimet), Dithiodemeton (Di Syston), and Guthion should be applied only by persons thoroughly familiar with their hazards and who will comply with all precautions!

XII. Some Factors to Consider When Applying Pesticides

FOR SAFETY'S SAKE

A. Keep accurate records of applications; include date, specific field, and amount used.

B. Calibrate application equipment carefully and frequently during the season.

C. Replace leaky hoses and connections.

INFORMATION SHEET

D. Follow the manufacturer's direction exactly.

E. To protect honeybees, do not spray plants in bloom with insecticides. Notify neighbors at least 48 hours before spraying so that they can protect their bees.

F. Don't use mouth to blow out clogged lines or nozzles.

G. Minimize drift by applying on a calm day.

H. Clean all equipment used in mixing and applying pesticides.

XIII. How to Dispose of Surplus Pesticides and Containers

FOR SAFETY'S SAKE

A. Neutralize the poisonous effect of the pesticide if there are directions on the label for doing so.

B. Don't dump into a sewage system or street gutter which drains into open water.

C. Don't drain the sprayer near a well, pond, or stream.

D. Don't discard pesticide or containers where soils, crops, water, or animals will be contaminated.

E. Puncture or crush metal containers (except aerosol) and bury in an isolated area or land-fill dump. Do not burn.

XIV. Proper Methods of Storing Pesticides

FOR SAFETY'S SAKE

A. Store in the original, labeled containers - NEVER in food or drink containers.

B. Discard unidentified pesticides.

C. Store in a dry, well-ventilated room or building away from food, feed, or seeds. Liquid pesticide should be stored in heated areas to prevent freezing.

D. Make sure storage area is secure from children, irresponsible persons, pets, and livestock. Keep storage area locked. Never store in medicine cabinets or under the kitchen sink.

E. Be sure caps are secure on bottles or cans and check regularly for leaks.

F. Do not store volatile weed killers like 2, 4-D and related herbicides with other wettable powders, dust, or seeds.

NOTE: The National Poison Control Center can be reached at 800-432-6866. Also, if your state has local poison control centers, list their numbers in an easy-to-see place.

INFORMATION SHEET

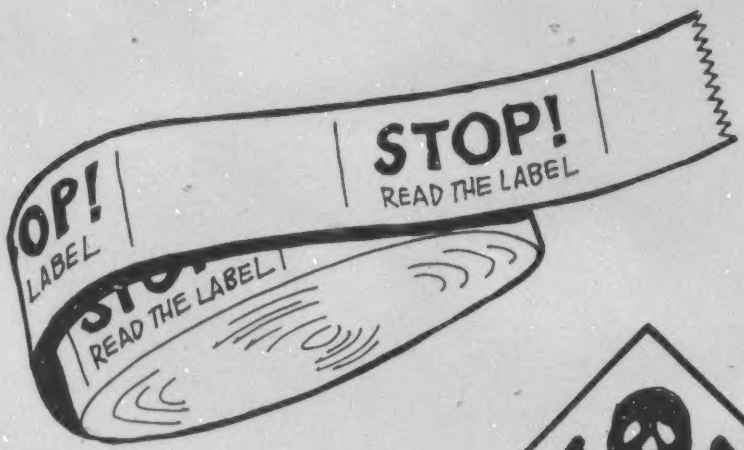
XV. Basic Pesticide Application Equipment

A. Power sprayer
B. Compound air sprayer
C. Trombone sprayer
D. Mist blower
E. Various size dusters
F. Aerosol bombs
G. Fumigant containers
H. Liquid drenches
I. Fogger
J. Complete set of protective clothing

Chemical Composition of Important Pesticides
(Excluding Herbicides)

CLASS OF MATERIAL	SPECIFIC EXAMPLE	MAJOR TYPE OF ACTION
Organic (Naturally occurring)		
antibiotics	streptomycin	bactericide
nicotine	nicotine sulphate	insecticide
pyrethrum		insecticide
rotenone		insecticide
oils	diesel oil	insecticide
Synthetic		fungicide
carbamates	ferbam	fungicide
	sevin	insecticide
chlorinated-hydrocarbons	DDT	insecticide
	DD	nematocide
mercury compounds	Ceresan, Semesan	fungicide, bactericide
organophosphates	malathion	insecticide, miticide
phthalimides	captan, phaltan	fungicide
pyrethrins		insecticide
Inorganic		
arsenic	lead arsenate	insecticide
copper	copper sulfate	fungicide, bactericide
mercury	mercuric chloride	fungicide, bactericide
sulfur	lime sulfur	fungicide

Key Words on Labels


STOP!
READ THE LABEL
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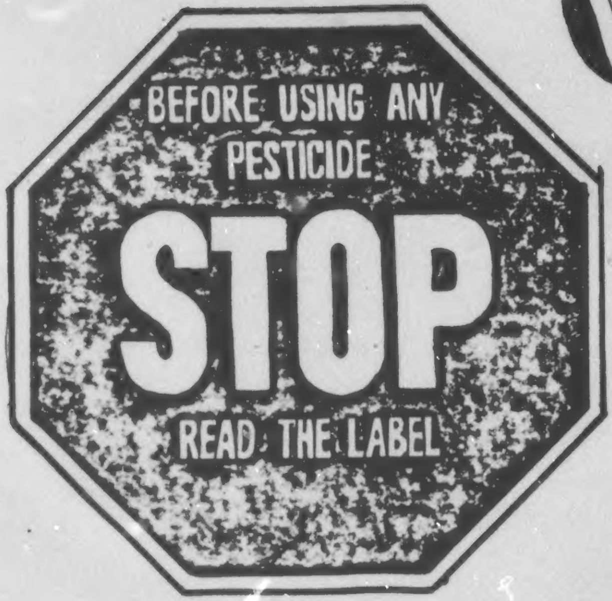
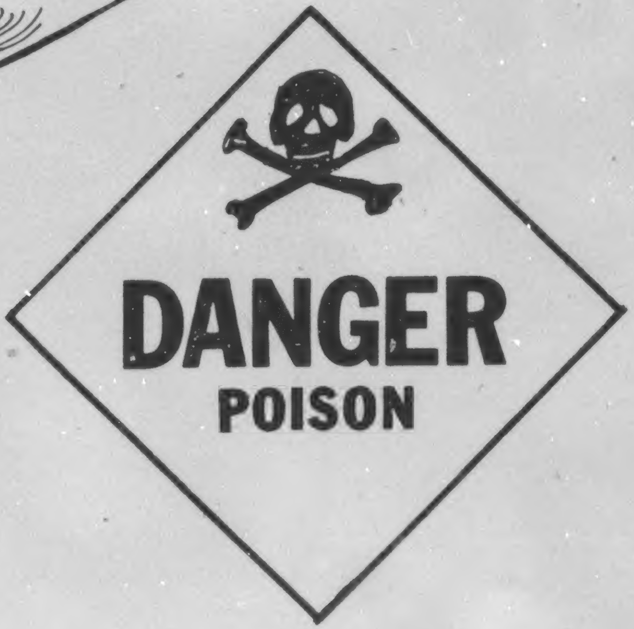
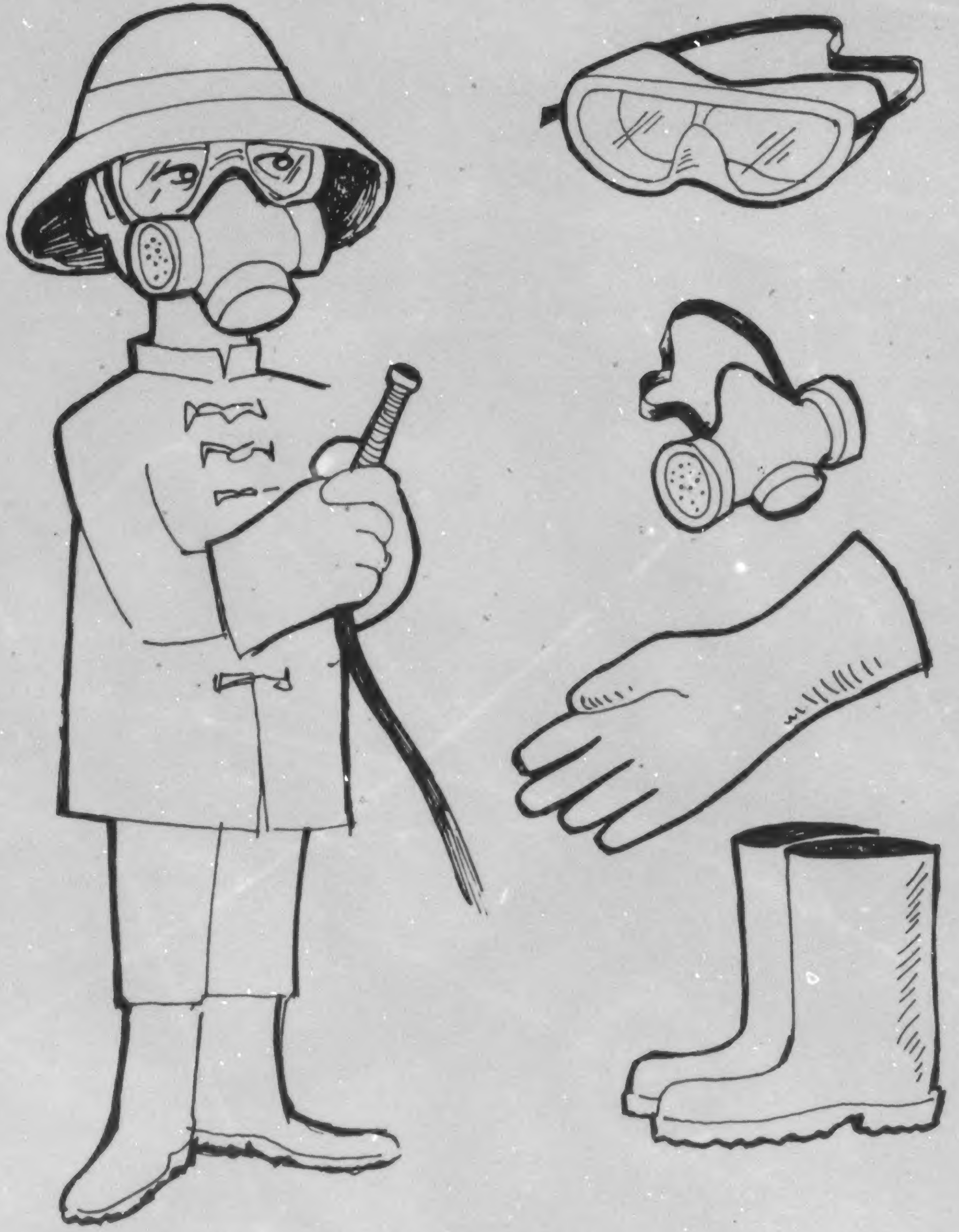

BEFORE USING ANY
PESTICIDE
STOP
READ THE LABEL


DANGER
POISON

TM 2

HORTII SG U2-11

Proper Spray Clothing



A Sample Label

Diazinon

Insecticide AG500

SAMPLE LABEL

For control of insects on fruits, nuts, vegetables, field crops, and ornamentals

Geigy

Active Ingredients:	**84%**
O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothiate	48%
Xylene	36%
Inert Ingredients:	**16%**
Total:	**100%**

Diazinon AG500 contains 4 lbs. Diazinon per gallon.

Warning:

Keep out of reach of children. May be fatal if swallowed. May be absorbed through the skin. Do not breathe spray mist. Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Avoid contamination of food and feed. Keep out of reach of domestic animals. Do not use on humans, household pets, or livestock. Do not permit children or pets to go on to sprayed grass until spray has completely dried.

Fish and Wildlife Caution:
This product is toxic to fish and wildlife. Birds feeding on treated areas may be killed. Keep out of lakes, streams or ponds. Apply this product only as specified on this label.
This product is highly toxic to bees exposed to direct treatment or residues on crops. Protective information may be obtained from your Cooperative Agricultural Extension Service.

Do not reuse empty container. Destroy it by perforating or crushing. Bury or discard in a safe place.

Minimum Flash Point: 82°F.
Do not use or store near heat or open flame.

EPA Reg. No. 100-461 AA

DIRECTIONS FOR USE AND CONDITIONS OF SALE AND WARRANTY

IMPORTANT: Read the entire **Directions For Use** and the **Conditions Of Sale And Warranty** before using this product.

Conditions Of Sale And Warranty

The **Directions For Use** of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application all of which are beyond the control of Geigy or the Seller. All such risks shall be assumed by the Buyer.

Geigy warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the **Directions For Use**, subject to the inherent risks referred to above. **Geigy makes no other express or implied warranty of Fitness or Merchantability or any other express or implied warranty.** In no case shall Geigy or the Seller be liable for consequential, special or indirect damages resulting from the use or handling of this product. Geigy and the Seller offer this product, and the Buyer and user accept it, subject to the foregoing **Conditions Of Sale And Warranty** which may be varied only by agreement in writing signed by a duly authorized representative of Geigy.

PLANT PROBLEMS AND CONTROLS

UNIT 2

ASSIGNMENT SHEET #1: Research on Pesticide Application Equipment

I. Visit a feed store, nursery, or farm equipment dealer and fill in the following chart.

Type of Applicator	Principal Uses	Advantages	Disadvantages	Safety Methods

PLANT PROBLEMS AND CONTROLS

UNIT 2

ASSIGNMENT SHEET #2: Research on Availability of Pesticides

I. Visit a feed store or nursery and fill in the following chart.

Name of Pesticide	Active Ingredients	Used How & For What Problem	Disadvantages	Safety Methods

PLANT PROBLEMS AND CONTROLS

UNIT 2

JOB SHEET #1: Pouring Concentrates

I. Equipment and Materials Needed:

   A. Galvanized steel containers

   B. Lids for all openings

   C. Transfer container

   D. Neutralizing agents

   E. Protective clothing

II. Procedure:

   A. Select the best pesticide for the job - the safest chemical which will kill this particular pest on this particular plant without danger to the plant or the consumer.

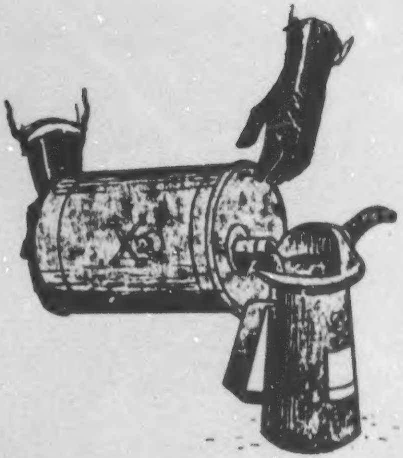
   B. Read the label on the pesticide container twice and take off preliminary formula calculations, first aid preparations and equipment and training preparations.

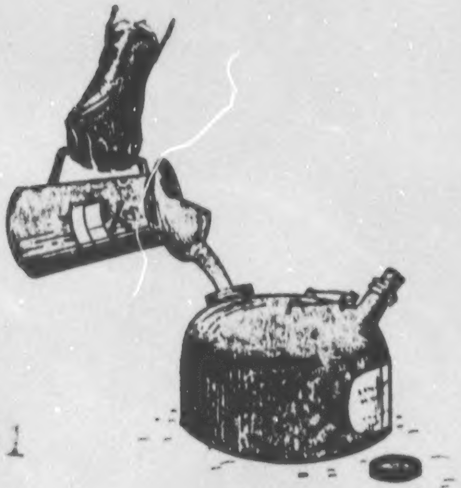
   C. Calculate again the amount of concentrate to be used for each load.

   D. Have a clean transfer container for each load. It must have a spout for pouring the concentrate and separate opening for filling and venting. Both openings must have tight fitting, screw type lids.

   E. Put on full protective clothing in the prescribed manner.

   F. Carefully open original concentrate container





JOB SHEET #1: Pouring Concentrates

G. Pour concentrates into the measuring container. Touch the spout of the concentrate container to the edge of the measuring container before you pour the liquid. Replace lid on concentrate container.

H. Pour the concentrate from the measuring container into the transfer container. Touch the spout of the measuring container to the edge of the opening into the transfer container before you start pouring the liquid. Repeat steps F & G for each load using a separate transfer container for each load.

I. Put the lids back tightly on the transfer containers.

J. Rinse measures. Return concentrates, empty containers, and clean measures to chemical storage room.

K. One man should hand the lightly capped transfer container to a man upon the sprayer. Both should be wearing complete suits of protective clothing.

L. The worker on the machine should remove the spout lid, loosen the other lid so it will function as a vent, and carefully pour the concentrated pesticide into the machine without splashing. The worker on the ground should move away from the sprayer.

M. The worker on the machine should tighten both lids on the transfer container before handing it down to the man on the ground. Transfer containers should be thoroughly rinsed before they are put in the locked chemical storage room between uses.*

*Commercial neutralizing agents may be used when cleaning contaminated equipment.

III. Be Sure To:

A. Always formulate outside in the open air.

B. Pour liquids carefully to prevent splashing.

C. Remove the screen on the spray tank before adding the concentrate.

D. Slurry wettable powders before adding to spray tank.

E. Avoid incompatible or unknown mixtures of chemicals.

PLANT PROBLEMS AND CONTROLS

UNIT 2

TEST

1. Match:

______a. Nematode
______b. Translocation
______c. Pesticide
______d. Spore
______e. Mycelium
______f. Herbicide
______g. Systemic action
______h. Toxic
______i. Colloid
______j. Fungicide
______k. Antidote

1. Poisonous.
2. Chemical substance used to kill herbaceous plants.
3. Very small roundworm which lives in the soil and frequently enters the plants through the roots.
4. Vegetative portion of a fungus.
5. Substance in a state between being in solution and in suspension.
6. Single cell, which when freed, develops into a new plant or animal.
7. Translocation of a pesticide from one part of the organism to another, affecting the toxic action throughout the organism's system.
8. The movement or conduction of water soluble organic materials and minerals from one part of the plant to another part.
9. A substance used to counteract the effect of poisons.
10. Generic name for all chemicals that kill fungi.
11. Generic name for all chemicals that kill plant pests at some stage of their life cycles.

2. List at least five chemical compounds classified according to their toxic effect.

3. Identify as True or False each of the following statements concerning stomach-and-contact poisons.

_____a. Used for the control of insects with either chewing or sucking or rasping mouth parts.
_____b. Some poisons are rotenone, chlordane, dieldrin, lindane, malathion, methoxychlor, parathion, and pyrethrum products.
_____c. Pyrethrum products are nonpoisonous to man.
_____d. Pyrethrum is very inexpensive.

TEST

4. Identify as True or False each of the following statements concerning contact poisons.

_____a. Used to control insects with sucking or rasping mouth parts.

_____b. Poisons penetrate through the insect body directly or through the breathing or sensory pores.

_____c. Nicotine sulfate is used for the control of many kinds of aphids.

_____d. Aramite is used for the control of phosphate-resistant red spider mites.

_____e. Oil emulsion for the control of scale and mealybugs.

5. Identify as True or False each of the following statements concerning systemic poisons.

_____a. Systemic poisons are non-chemical compounds which enter the soil to make it pliable.

_____b. Systemic poisons may be applied as a foliage spray or to the soil.

_____c. Use of systemic poisons is limited to nonedible crops.

_____d. Systemic poisons are chemical compounds which enter the conducting systems of plants.

6. Identify as True or False each of the following statements concerning fumigants.

_____a. Fumigants are chemical compounds which change from either the solid or liquid form to the vapor or gaseous form.

_____b. Fumigants stop the respiration of insects and nematodes and enter the cells of fungi and bacteria.

_____c. Fumigants are never applied to the soil or crops growing in a greenhouse.

_____d. Fumigant chemicals pllied to the soil are chloropicrin, methyl bromide, Nemagon, Vapam, and VO-13.

_____e. Aerosols can be used in an enclosure.

7. Identify as True or False each of the following statements concerning seed and seedstock treatment materials.

_____a. Seed and seed-stock materials are chemical compounds which are applied to the surface of seeds, tubers, bulbs, and fleshy roots.

_____b. Seed and seed-stock materials do not protect young plants against certain types of fungi or bacteria.

_____c. Seed and seed-stock materials, applied in carefully measured doses, kill the cells of bacteria of fungi and at the same time do no damage to seedling plants.

_____d. Some examples of seed and seed-stock chemicals are mercuric chloride, Captan, Chloronil, Diclone, and thiram.

TEST

8. Identify as True or False each of the following statements concerning fungicides and/or bactericides.

_____a. Fungicides and/or bactericides are used to prevent or inhibit the growth of germinating spores, mycelium of fungi, or the cells of certain bacteria on the surface of the plant.

_____b. Once enemy organisms have successfully invaded plant tissue, the use of fungicides and/or bactericides is ineffective.

_____c. The timing of the application of fungicides and/or bactericides is not important.

_____d. Application of fungicides and/or bactericides should be made just before a rain.

_____e. Bordeaux mixture is made from copper sulfate and fresh hydrated lime in a suspension with water.

9. Identify as True or False each of the following statements concerning antibiotics.

_____a. Antibiotics are definite chemical compounds which are made by a given organism for its protection against disease-producing organisms.

_____b. The fungus Penicillium-notatum makes and secretes the antibiotic penicillin for protection against its bacterial enemies.

_____c. Antibiotics are effective against certain diseases caused by fungi.

_____d. Antibiotics are non-systemic in action.

_____e. Antibiotics are applied in a solution of water and are absorbed into the plant sap.

10. Name at least four factors to consider when selecting a pesticide.

11. Name at least five factors to consider when handling and mixing pesticides.

12. Identify as True or False each of the following statements concerning the application of pesticides.

_____a. Keep accurate records of applications.

_____b. Calibrate application equipment carefully and frequently.

_____c. Replace leaky hoses and connections.

_____d. Never look at the manufacturer's directions.

_____e. To protect honeybees, do not spray plants in bloom.

_____f. Don't use mouth to blow out clogged lines or nozzles.

13. List three ways to dispose of surplus pesticides and containers.

TEST

14. Identify as True or False each of the following statements concerning proper methods of storing pesticides.

_____a. Store in original, labeled container.

_____b. Discard unidentified pesticides.

_____c. Store in a dry, well-ventilated room away from food, feed, or seeds.

_____d. Liquid pesticide can be frozen.

_____e. Make sure storage area is secure from children.

_____f. Keep storage area locked.

_____g. Do not store volatile weed killers with other wettable powders, dust, or seed.

15. List at least five kinds of pesticide application equipment.

PLANT PROBLEMS AND CONTROLS

UNIT 3

PLANT DISEASES

TERMINAL OBJECTIVES

Upon completion of this unit, students will be able to define terms pertaining to plant diseases; to state the basic pathogenic and nonpathogenic diseases; to identify habits, reproduction, controls, and effects of plant diseases; and to state facts concerning the plant diseases of mycoplasma and nematodes. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this, students will be able to:

1. Match definitions with terms that relate to plant diseases.
2. Name two basic types of plant diseases.
3. List the three basic pathogenic diseases.
4. Identify as true or false given phrases concerning bacteria.
5. List four diseases caused by bacteria.
6. Choose from given statements those that apply to habits of bacteria.
7. Identify as true and false given phrases concerning fungi.
8. Choose from given statements those that apply to a description of a fungi.
9. Select from given statements those that are true or false concerning the reproduction processes of fungi.
10. Identify as true or false given statements concerning habits of fungi.
11. Choose from given statements those that apply to facts about viruses.
12. Name at least four symptoms of virus diseases.
13. List three plants that viruses generally attack.
14. Identify as true or false given phrases concerning mycoplasma.
15. List at least three plants that are affected by aster yellow which is of mycoplasma origin.
16. List two methods of controlling mycoplasma.
17. Identify as true or false given statements concerning nematodes in relation to plant diseases.
18. List three basic controls of nematodes.
19. Identify as true or false given statements concerning nonpathogenic diseases.
20. State two examples of a nonpathogenic disease.

PLANT PROBLEMS AND CONTROLS

UNIT 3

INFORMATION SHEET

I. Terms and Definitions

A. Stomata - An opening in the epidermis of the leaf through which the gases, carbon dioxide (CO_2), oxygen (O_2), and water vapor (H_2O) enter and exit the plant.

B. Chlorophyll - The green vegetable pigment of plants essential in the process of photosynthesis.

C. Toxins - Poisons.

D. Vascular - Describing tissue made up of vessels and ducts.

E. Rosaceae - A plant family: some examples - rose, cotoneaster, hawthorn, spirea, Japanese quince, flowering crab, pyracantha, and mountain ash.

F. Canker - A disease of fruit trees; an indented, shrunken spot, usually dark brown to purple in color.

G. Parasites - Fungi that obtain their food from living plants.

H. Saprophytes - Fungi that obtain their food from dead plants.

I. Hyphae - A long thread-like usually branching body in the reproductive portion of the fungi.

J. Mycelium - Vegetative portion of fungi.

K. Spore - A single cell, which when freed, develops into a new plant or animal.

L. Nematodes - Very small worm-like animal organisms that suck plant juices from plant cells.

M. Mycoplasma - A relatively newly discovered organism with elongated branched filaments that can pass through bacteria filters; causes diseases previously thought to be caused by viruses.

N. Lesion - An injury that often causes a change in tissue or organ structure.

O. Pathogen - Any agent capable of producing disease; especially a micro-organism or virus.

II. Basic Types of Plant Diseases

A. Pathogenic - Pertains to plant disorders that arise from living organisms.

B. Non-pathogenic - Pertains to plant disorders that arise from some cause other than living, disease-causing organisms (pathogens).

INFORMATION SHEET

III. Basic Pathogenic Diseases

- A. Bacterial diseases
- B. Fungal diseases
- C. Viral diseases

IV. Facts About Bacteria

- A. Bacteria are one-celled plants that increase in number by division under favorable conditions.
- B. Bacteria are plants that have no chlorophyll and obtain their food from either living or dead organic material.
- C. There are approximately 160 species of bacteria that cause diseases in plants.
- D. Bacteria are rod-shaped, and can be studied when magnified 800-1000 times in a compound microscope.

V. Types of Diseases Caused by Bacteria (See TM 3 and TM 4)

- A. Soft rot - The plant tissue becomes soft and mushy.
- B. Leaf spot - Small local lesions can be seen on the leaves.
- C. Extensive blight - Large lesions that may involve the whole leaf.
- D. Gall - Swelling of tissue, or tumors.
- E. Wilt - A vascular disorder.

VI. Habits of Disease Bacteria

- A. They live in the soil, or on dead or decaying plants.
- B. They are spread by wind, rain, man, animals, equipment, and plants.
- C. They do not penetrate healthy plant tissue; a wound of some type is necessary before the bacteria can enter the plant.
- D. They may enter the plant through the stomates in the leaves.
- E. When they enter the plant a few cells die, resulting in a spot.
- F. They may produce toxins that poison the plant.
- G. They may plug the vascular (water and food conducting) tissues, resulting in wilting.

INFORMATION SHEET

VII. Facts About Fungi

A. Are among the lower forms of plant life.

B. Are plants that contain no chlorophyll and obtain their food from either living or dead organic matter.

1. Parasites are fungi that obtain their food from living plants.

2. Saprophytes are fungi that obtain their food from dead plants.

C. Are microscopic in size.

D. Cause the largest share of diseases in higher plants.

IX. Reproduction Processes of Fungi (See TM 1)

A. Most common form of fungal reproduction is by means of spores.

1. Some spores develop rapidly (under favorable conditions) and spread diseases rapidly.

2. Other spores are easily killed when growing conditions are not favorable.

3. Still other spores can endure long periods of unfavorable conditions.

B. Spores can be carried by wind, by water, and on seeds, cuttings, bulbs, and other plants.

X. Habits of Fungi

A. Food is withdrawn from the cells of the plant by the tissue-penetrating hyphae.

B. Fungi can invade a healthy plant through cells even when plant is not wounded.

C. Fungi damage plants by forming toxins in plant cells that are passed to other plant cells causing them to die.

XI. Facts About Viruses

A. Viruses are the least understood of all the basic organisms that cause plant diseases.

B. Are spread from one plant to another by means of insects that have sucked juices of infected plants.

C. Aphids and leafhoppers are the most frequent insects that carry viruses.

INFORMATION SHEET

XII. Symptoms of Viral Diseases

A. Veinclearing

B. Mosaic or mottling pattern

C. Ringspot

D. Streaks

E. Yellowing

F. Stunting and malformation

XIII. Kinds of Plants That Viruses Generally Attack (under greenhouse conditions)

A. Carnations

B. Chrysanthemums

C. Geraniums

XIV. Mycoplasma - A Recent Discovery of a New Class of Organisms

A. Sometimes mycoplasma causes diseases previously thought to be caused by viruses.

B. Mycoplasma escaped detection for years because of their small size and their ability to pass through bacteria filters.

C. Definition means "fungus form," and has to do with the elongated, branched filaments of the organism that resemble the hyphae in fungus.

XV. Suspected Diseases Caused by Mycoplasma and Description

A. A group of disease called "yellows" previously thought to be caused by viruses.

B. Primary form of transmission from one plant to another is by leafhoppers.

INFORMATION SHEET

C. Some plants affected by aster yellows are:

1. Petunias
2. Chrysanthemums
3. Asters

XVI. Methods Used to Control Mycoplasma Diseases

A. Some antibiotics will control the infection.

B. Much work in research will be required to regroup and reclassify some of the "unknown" organisms, before complete control is attained.

XVII. Facts About Nematodes in Relation to Plant Diseases

A. Nematodes are different from the other types of organisma discussed in that they belong to the animal kingdom.

B. Nematodes are sometimes referred to as eelworms; they are NOT closely related to earthworms, flat worms, wireworms, grubs, or cutworms; they are in a separate class.

C. Nematodes are present in the soil (hundreds of millions within a single acre of soil).

D. Nematodes are usually too small to see by the naked eye; they are very slender and have a highly complex body makeup.

E. Nematodes reproduce in a few days to a few weeks, depending on climatic conditions.

F. Nematodes are specialized in the plants they feed upon; their nail-like mouth parts are inserted into the plant cell, a digestive substance is injected into the cell, and then the plant juices are sucked out.

G. A cell that is punctured by a nematode dies; the puncture holes are ideal entrance ways for other types of disease organisms.

XVIII. Basic Control of Nematodes

A. Sanitation

B. Crop Rotation

C. Plant nematode-resistant varieties of crops.

XIX. Non-Pathogenic Diseases

A. Plant disorders that arise from some cause other than living disease causing organisms (pathogens).

B. Not always considered diseases per se.

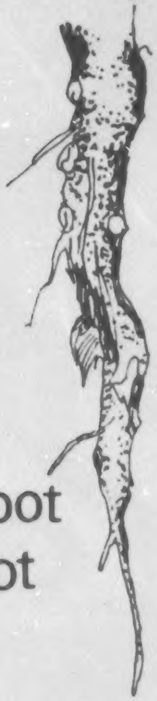
INFORMATION SHEET

XX. Some Examples of Non-Pathogenic Disease

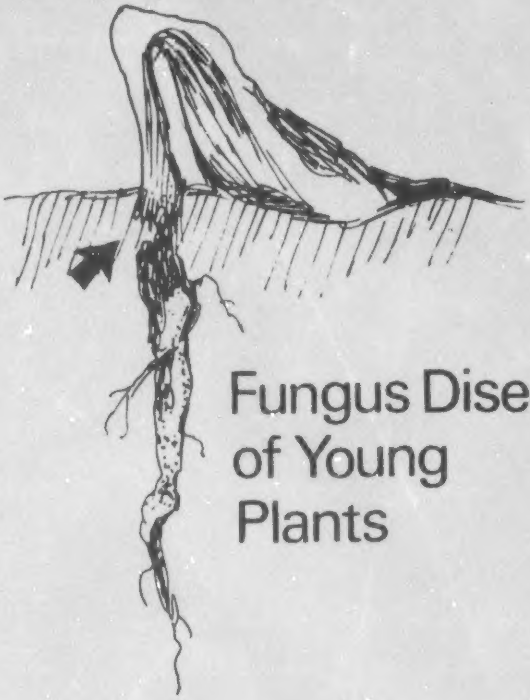
A. Iron chlorosis - Yellowing of leaves, resulting in reduction in the normal amount of chlorophyll, thus stunting plant. Entire terminals may die.

B. Other mineral deficiency - Depending on the mineral, cause many irregularities in the plant.

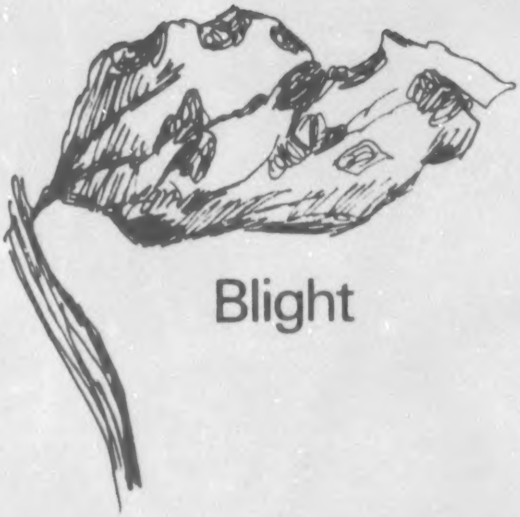
Fungus Diseases



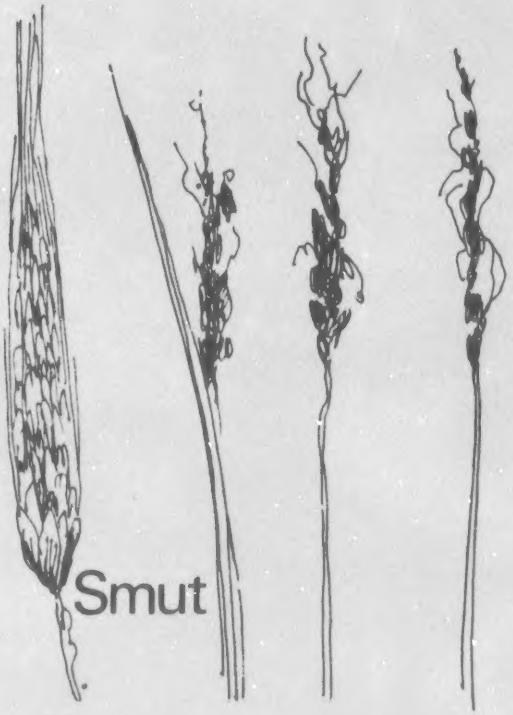
Root Rot



Fungus Disease of Young Plants

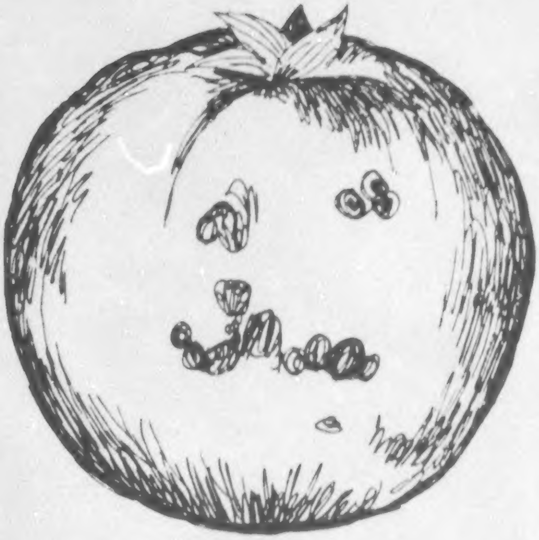


Blight

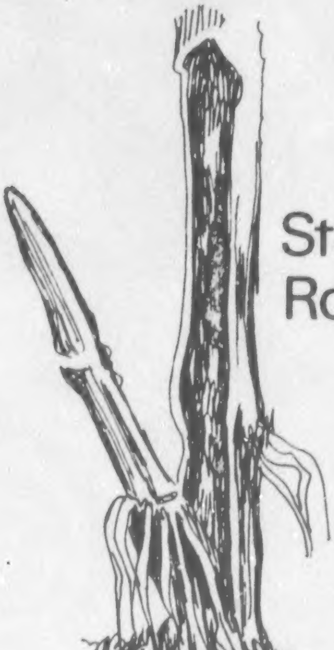


Smut

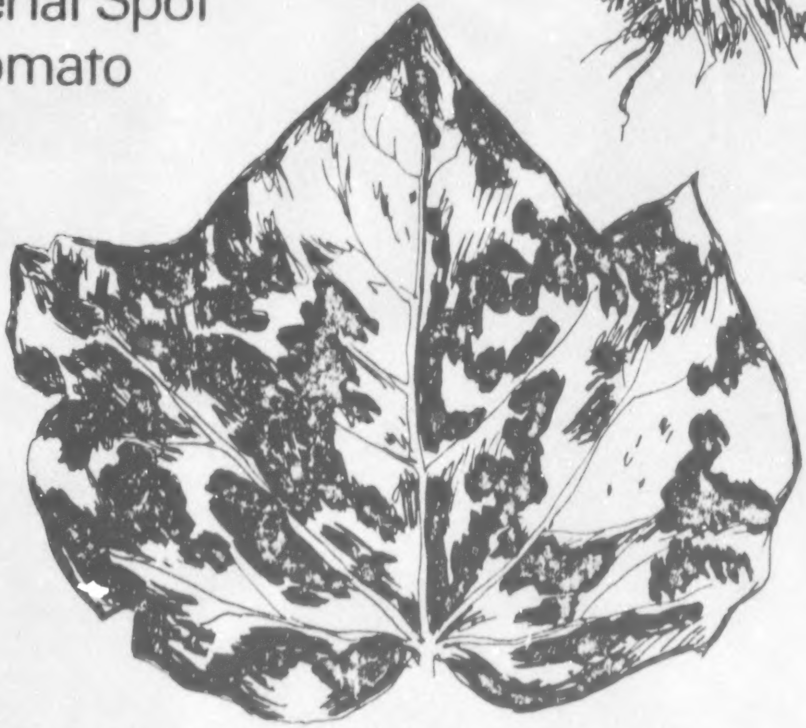
Bacterial Diseases



Bacterial Spot on Tomato

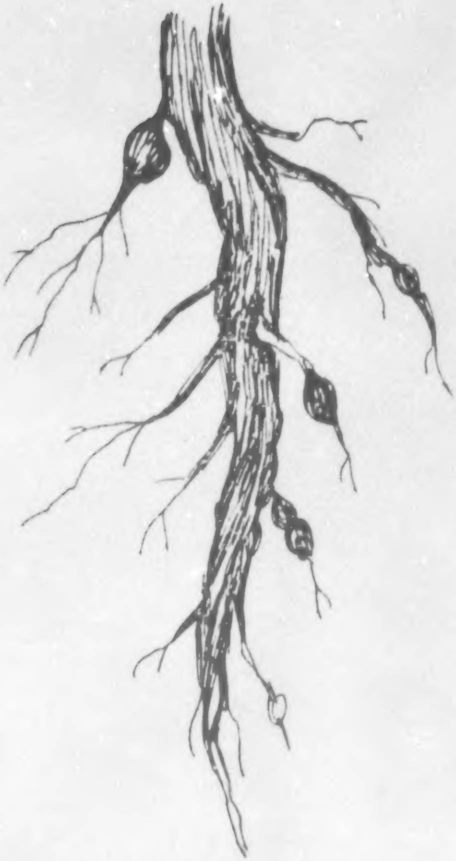


Stalk Rot

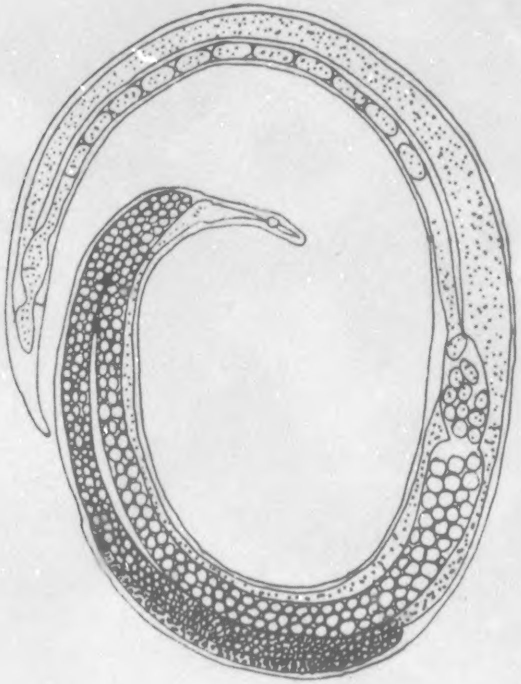


Cotton Leaf Blight

Nematode Diseases



Root Galls

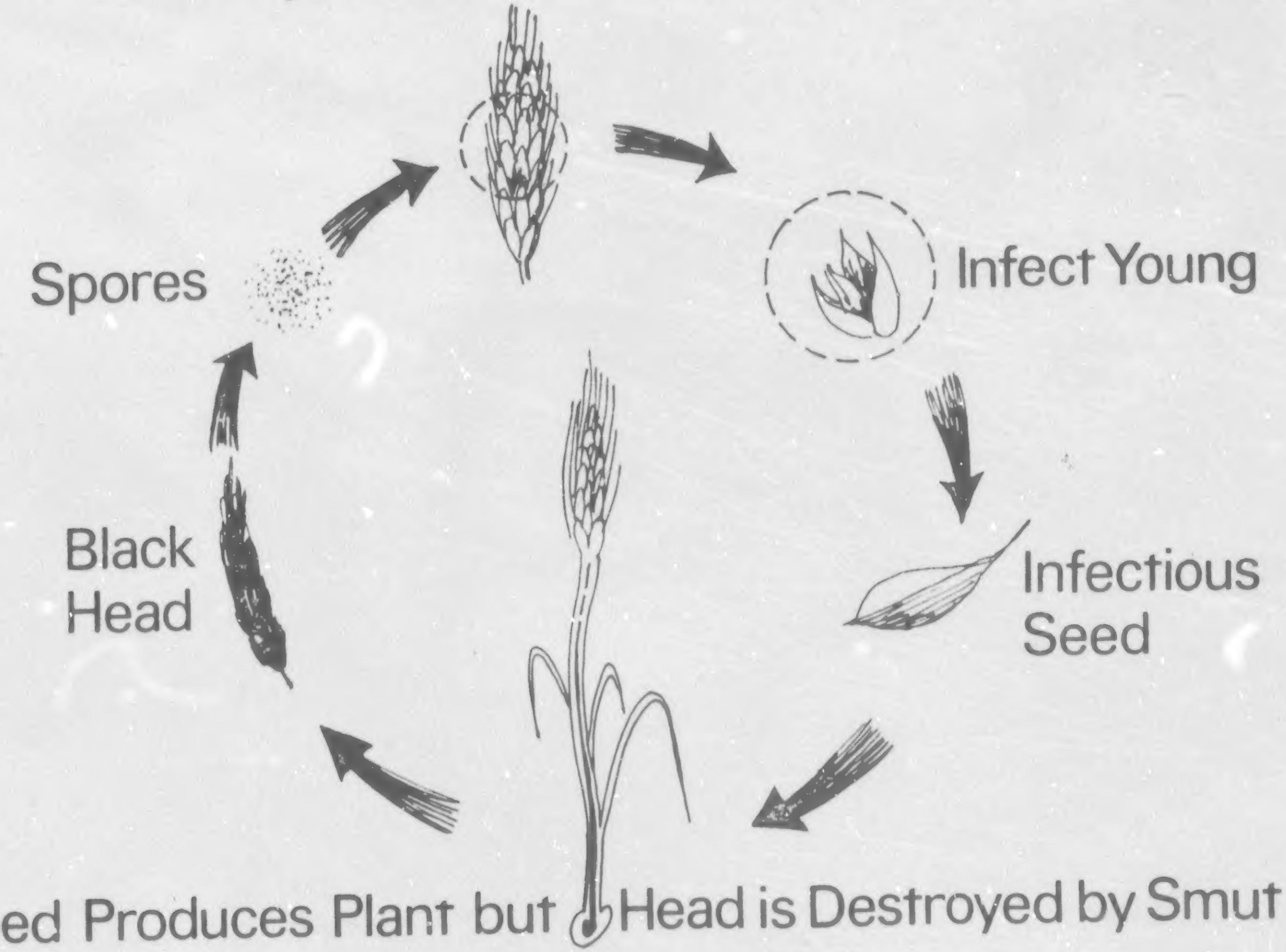


Nematode

TM 3

HORT II SG U3-12

Life Cycle of Smuts (Fungus)



Infect Young

Infectious Seed

Seed Produces Plant but Head is Destroyed by Smut

Black Head

Spores

PLANT DISEASES, SYMPTOMS, AND CONTROLS

Plant Diseases	Symptoms	Controls
Mildew	Yellowish angular spots on older leaves. Fruit not affected. Leaves dry, curls, and die. Fungi not carried on seeds and does not over winter in soil.	Dust or spray with a fixed copper fungicide or an organic fungicide. Do not apply fe Grow mildew resistant varieties.
Leaf Spot	Small, round spots with light tan centers and dark brown borders on leaves. Fungi is carried on seeds and lives in soil or on remains of diseased plants.	Dust or spray with a fixed copper fungicide. Apply captan. Usually does not need regular treatment. Spray just before blossoms open and within a day after each rain during ripening season.

PLANT PROBLEMS AND CONTROLS
UNIT 3

ASSIGNMENT SHEET #1: Surveying for Plant Disease Damage

I. Survey your local community and collect ten specimens of plants that are diseased. List the plant below and identify the disease.

	Plant	Disease
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

PLANT PROBLEMS AND CONTROLS

UNIT 3

ASSIGNMENT SHEET #2: Select Five Plants from nursery and keep a record.

DATE	PLANT PROBLEM	CAUSE	PREVENTION AND/OR CONTROL	COMMENTS

PLANT PROBLEMS AND CONTROLS

UNIT 3

TEST

1. Match:

_____a. Vascular
_____b. Stomate
_____c. Canker
_____d. Chlorophyll
_____e. Toxins
_____f. Parasites
_____g. Rosaceae
_____h. Saprophytes
_____i. Hyphae
_____j. Spore
_____k. Mycelium
_____l. Nematodes
_____m. Mycoplasma
_____n. Pathogen
_____o. Lesion

1. The green vegetable pigment of plants essential in the process of photosynthesis.
2. Fungi that obtain their food from dead plants.
3. A single cell, which when freed, develops into a new plant or animal.
4. Vegetative portion of the fungi.
5. A disease of fruit trees; an indented, shrunken spot, usually dark brown to purple in color.
6. A long thread-like, usually branching body in the reproductive portion of the fungus.
7. Fungi that obtain their food from living plants.
8. An opening in the epidermis of the leaf through which the gases, carbon dioxide, oxygen, and water vapor, enter or exit the plant.
9. Describing tissue made up of vessels and ducts.
10. Very small worm-like animal organisms that suck plant juices from plant cells.
11. A plant family.
12. Any agent capable of producing disease; especially a micro-organism or virus.
13. Poisons.
14. An injury that often causes a change in tissue or organ structure.
15. A relatively newly discovered organism with elongated branched filaments that can pass through bacteria filters; causes diseases previously thought to be caused by viruses.

2. Name two basic types of plant diseases.

TEST

3. List the three basic pathogenic diseases.

4. Identify as True or False each of the following statements concerning bacteria.

_____a. Are one-celled plants that increase in number by division under favorable conditions.

_____b. Are plants that have an abundance of chlorophyll.

_____c. There are approximately 160 species that cause diseases in plants.

_____d. Are rod-shaped and can be studied when magnified 800-1000 times.

5. List at least four diseases caused by bacteria.

6. Choose from the following phrases those that apply to habits of disease bacteria.

_____a. They live in the soil or on dead or decaying plants.

_____b. They are spread by wind, rain, man, animals, equipment and plants.

_____c. They do not penetrate healthy plants; a wound of some type is necessary before the bacteria can enter the plant.

_____d. They do not enter through the stomates of the leaves.

_____e. They might produce toxins or plug the vascular conducting tissue of the plant, causing death to the plant.

7. Identify as True or False each of the following phrases concerning fungi.

_____a. Are among the lower forms of plant life.

_____b. Are plants that contain no chlorophyll and obtain their food from either living or dead organic matter.

_____c. Parasites are fungi that obtain their food from living plants.

_____d. Saprophytes are fungi that obtain their food from living plants.

_____e. Are microscopic in size.

8. Choose from the following phrases those that apply to a description of fungus.

_____a. Made up of thread-like filaments called hyphae; these hyphae together compose a mycelium.

_____b. Mycelium is never visible.

_____c. May occur within plant and not be visible on the surface.

_____d. May be a powdery mildew on the surface.

_____e. May cause wilting of the plant.

TEST

9. Select which of given statements about the reproduction processes of fungi are True and which are False.

_____a. Most common form of reproduction is by means of spores.

_____b. Diseases are not spread rapidly by spores.

_____c. Spores can be carried by wind, by water, and on seeds, cuttings, bulbs, and other plants.

10. Identify as True or False each of the following statements concerning habits of fungi.

_____a. Food is withdrawn from the cells of the plant by the hyphae which penetrates the tissue.

_____b. Fungi can invade only healthy plants through a wound.

_____c. Fungi damages plants by forming toxins in plant cells that are passed to other plant cells causing them to die.

11. Choose from the following phrases those that apply to facts about viruses.

_____a. Are the least understood of all the basic organisms that cause plant diseases.

_____b. Are spread from one plant to another through the feeding of insects that suck the juices of the plants.

_____c. Are not carried by aphids and leafhoppers.

_____d. Are spread by pinching and disbudding.

_____e. Can be seen through a very powerful microscope.

_____f. Are carbohydrate in nature.

12. Name at least four symptoms of virus diseases.

13. List three plants that viruses generally attack.

14. Identify as True or False each of the following phrases concerning mycoplasma.

_____a. A disease thought to be caused by viruses.

_____b. A recent discovery of a new class of organisms causing plant disease.

_____c. Mycoplasma escaped detection for years because of their small size and their ability to pass through bacteria filters.

_____d. Definition means "fungus form".

_____e. Is not an important discovery.

15. List at least three plants that are affected by aster yellows which is of mycoplasma origin.

TEST

16. List two methods of controlling mycoplasma.

17. Identify as True of False each of the following phrases concerning nematodes in relation to plant disease.

_____a. They belong to the plant kingdom.

_____b. Sometimes referred to as ellworms.

_____c. Are present in the soil.

_____d. Are usually too small to see by the naked eye.

_____e. Have a highly complex body makeup.

_____f. Do not reproduce very often.

18. List three basic controls of nematodes.

19. Identify as True or False each of the following statements concerning non-pathogenic diseases.

_____a. Non-pathogenic diseases are plant disorders that arise from some cause other than living disease-causing organisms (pathogens).

_____b. They are always considered diseases per se.

20. State two examples of a non-pathogenic disease.

PLANT PROBLEMS AND CONTROLS

UNIT 4

INSECTS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define the terms that pertain to insects; to describe the importance of insects and their value; the different metamorphoses of various insects, the life cycles of various types of insects, and methods of preventing losses from insects. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Match insect terms with their definitions.
2. Identify as true or false given statements concerning insects.
3. Choose from given statements those that apply to the value of beneficial insect species.
4. List five methods of controlling insects.
5. State the types of metamorphosis in insects.
6. State two facts concerning insects that go through "no metamorphosis" and name an example.
7. Identify as true or false given statements concerning insects that go through "incomplete metamorphosis".
8. Choose from given statements those that apply to facts concerning insects that go through "gradual metamorphosis".
9. Select from given statements those that apply to facts concerning insects that go through "complete metamorphosis".
10. Identify as true or false given statements concerning the life cycles of insects.
11. Name two ways damage by insects may be reduced.
12. List three methods of reducing damage by insects through prevention.
13. Choose from given statements those that apply to methods of reducing damage by insects through control.

PLANT PROBLEMS AND CONTROLS
UNIT 4
INFORMATION SHEET

I. Terms and Definitions.

A. Pollinate - To transfer pollen from anthers to stigmas (plant parts).

B. Predator - An animal constituted for living by preying on others.

C. Parasite - An animal constituted for living off other animals, such as larvae that develop in the eggs, young, or adults of other insects.

D. Metamorphosis - A change in form during development.

E. Molt - Shed skin.

F. Habitat - The nature of the environment in which a species lives.

G. Scavenger - An animal that lives on animal and vegetable debris.

H. Insecticide - A substance that kills insects.

I. Pesticide - Generic name for all chemicals that are toxic to some stage of a plant pest cycle.

II. Some Facts About Insects.

A. The average insect population per square mile is estimated to be equal to the total world population of people.

B. Insect destruction of crops by insects in the United States ranges from four billion to fifteen billion dollars annually.

C. Forest insects destroy more wood than forest fires do.

D. Termites consume about 100 million dollars' worth of wood structures a year.

E. One year's effort of a million workers is cancelled because of insects.

F. Still, only about one percent of the nearly one million insect species are pests to man, to useful plants, and to his domestic animals.

III. Value of Beneficial Insect Species.

A. Bees, wasps, flies, butterflies, and other insects pollinate flowers that in turn provide fruits, vegetables, and beauty.

B. Important commercial products such as honey, wax, and silk are obtained from some insects.

C. Fishes, birds, and other animals feed on insects.

D. Other insects are parasites or predators of damaging pests, or are scavengers of animal and vegetable debris.

NOTE: Control measures used against harmful insects must be weighed carefully to determine the ultimate effect on all living things, including man.

INFORMATION SHEET

IV. Methods of Controlling Harmful Insects (Block 1, Unit).

A. Legal
B. Cultural
C. Physical
D. Chemical
E. Biological

V. Types of Metamorphosis in Insects. (See TM 1)

A. Some insects go through no metamorphosis.
B. Some insects go through imcomplete metamorphosis.
C. Some insects go through gradual metamorphosis.
D. Some insects go through complete metamorphosis.

VI. Facts About Insects That Go Through "No Metamorphosis".

A. When the young hatch from the egg, they look exactly like the adult except for their size.
B. Location of some of their spines are different as an adult.
C. Example: Aphid.

VII. Facts About Insects That Go Through "Incomplete Metamorphosis".

A. Immature stages of these insects are found in water.
B. The adults are found flying in the air.
C. These insects in young stage are called "naiads."
D. Naiads only slightly resemble the adults into which they develop.
E. Naiads grow for a period of time, then molt; grow again, then molt again.
F. After the last molt, they have developed wings for flying.
G. Examples: mayflies, dragonflies, and stoneflies.

VIII. Facts About Insects That Go Through "Gradual Metamorphosis"

A. Newly hatched young resemble the adult in general body form, but lack wings.
B. Newly hatched young, called nymphs, undergo a series of feeding stages followed by molts.
C. After each molt, the nymph resembles the adult more and more.
D. Both nymphs and adults have the same type of mouth parts and food habits, and they thrive in the same habitat.

INFORMATION SHEET

E. Examples: grasshoppers, squash bugs, and aphids.

IX. Facts About Insects That Go Through "Complete Metamorphosis".

A. This is the most common type of metamorphosis.

B. Complete metamorphosis includes four developmental stages - egg, larva, pupa, and adult.

C. The larva is quite different in form from the adult.

D. The larva may pass through several stages, molting after each stage, but will not resembel the adult as in gradual metamorphosis.

E. All larvae have chewing or modified chewing mouthparts.

F. When the larva has reached maturity and cases to feed, it transforms into the pupa.

G. The pupa is an inactive stage of the insect in which it does not feed, but during which drastic changes take place.

H. In the pupal stage the process of changing a worm-like body into that of an adult is completed.

I. It takes a period of a few days to several months, depending upon the insect and the environment, for the adult to emerge from the pupal stage.

J. Examples: moth, fly, beatle, bee.

X. Life Cycles of Insects (See TM 2 and TM 3)

A. An insect's life cycle is divided into two seasons:

1. Active season - When the insect is active in its various stages.

2. Dormant season - When there is no activity by the insect.

B. Overwintering stage is an important factor in controlling the insect during the next season, by burning trash piles or clumps of weeds.

C. If an insect has several life cycles within a crop growing season then measures of control must be taken more than once during the growing season.

D. Knowing the stage of the life cycle in which the insect is doing damage, and when it is most susceptible, is necessary to effective control of an insect.

E. To destroy an insect's life cycle, follow the directions on the label of the pesticide. DO NOT deviate from the manufacturer's instructions.

XI. Ways to Reduce Damage by Insects.

A. Through prevention.

B. Through control.

XII. Methods of Reducing Damage by Insects Through Prevention.

INFORMATION SHEET

A. Barriers - Such as screen doors; oils and other materials used to prevent insects from entering fields, buildings, and places where they are not wanted.

B. Quarantines - (See Unit 1)

C. Special Crop Production Practices.

1. Fall or winter plowing to kill insects by freezing.
2. Timing the planting so that plant emergence and growth will occur when the insect is not present.
3. Planting a resistant variety that either will repulse or resist insects.
4. Planting attractant crops - alternate crops that attract insects more than the main crop.
5. Planting repellent crops - alternate crops that repel insects from the area of the main crop.
6. Crop rotation - alternating places to plant crops each year.

XIII. Methods of Reducing Damage by Insects through Control.

A. By correctly identifying the insect and the damage it does.

B. By knowing the life cycle habits of harmful insects, and particularly the "weak link" in the cycle when they can be more easily controlled.

C. By knowing how to prevent insect infestations.

D. By knowing how to select the correct insecticide to use.

E. By using approved and safe methods when applying insecticides.

F. By enabling predator insects to control pests.

NOTE: There are numerous pests other than insects that may require control; for example: slugs, snails, spiders, certain birds, animals (including human beings). Check with your instructor as to special controls for these other pests that apply to your locality.

The Orders of Insects

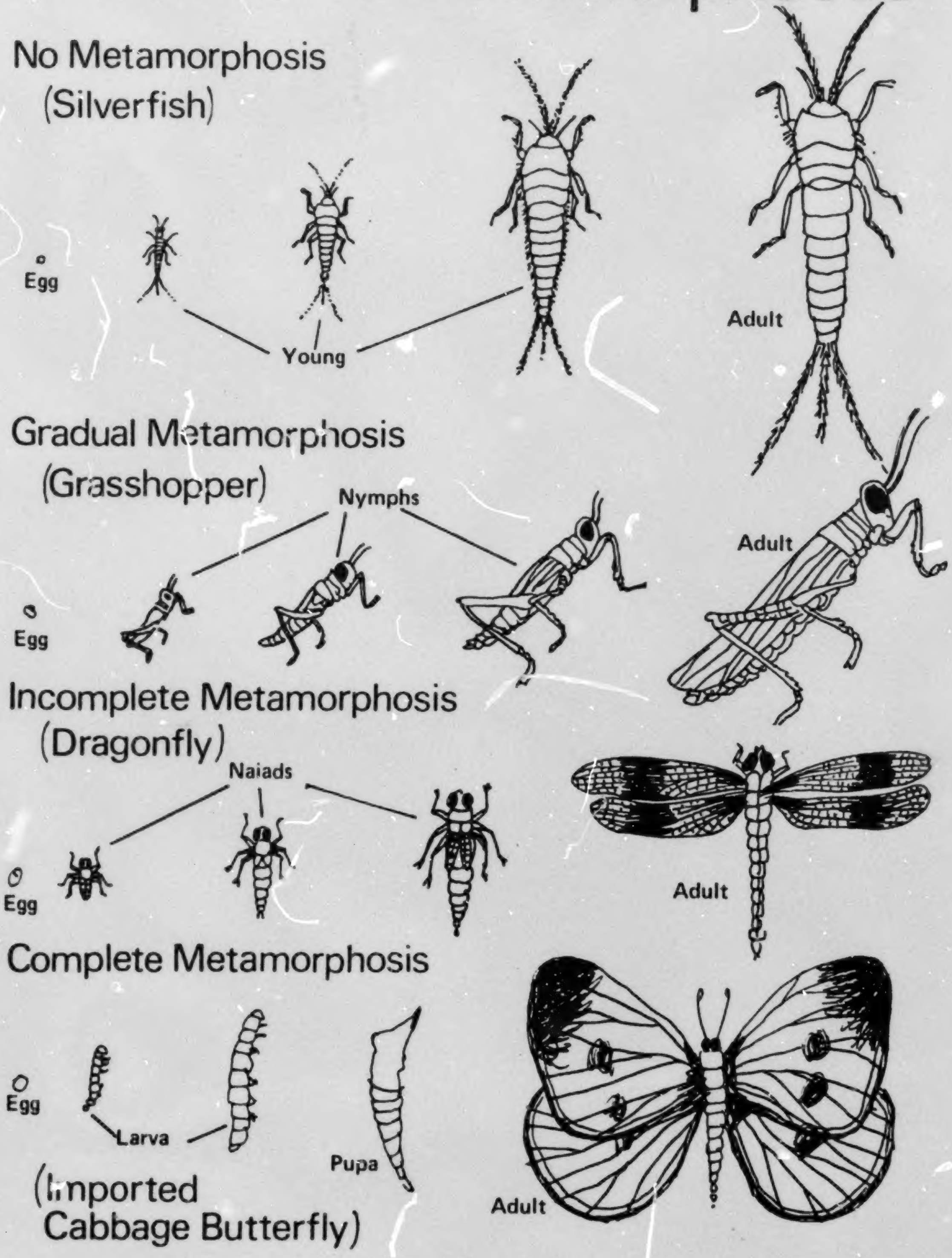
(Orders Important to Horticulture)

ORDER OF INSECT	EXAMPLE	MOUTH PART	METAMORPHOSIS*	MAJOR DAMAGES
1. Coleoptera (40% of all insects)	beetles, weevils, cereal leaf beetle	chewing	complete (egg, larva, pupa, adult)	crop and livestock stored grains
2. Diptera	Flies, mosquitoes, gnats	sucking, sponging, piercing-sucking	complete (egg, larva, pupa, adult)	crop and livestock production
3. Lepidoptera	butterflies, moths, Indian meal moth	adults — sucking larvae — chewing	complete (egg, larva, pupa, adult)	crops
4. Hemiptera	stink bug leaf bug	sucking	gradual (egg, nymph, adult)	crops
5. Homoptera	aphids, leafhoppers, cicadas, whiteflies, scale mealybugs	piercing-sucking	gradual (egg, nymph, adult)	crops
6. Orthoptera	grasshoppers, crickets, roaches	chewing	gradual (egg, nymph, adult)	crops
7. Hymenoptera	bees, wasps, ants	chewing chewing-lapping (bees)	complete (egg, larva, pupa, adult)	beneficial (bees) parasitic feeders on plants.
8. Ephemerida	mayfly	no mouth	incomplete	beneficial
9. Insecta	dragonfly	chewing	incomplete	beneficial predator on flies and mosquitoes

*Best steps for control are underscored

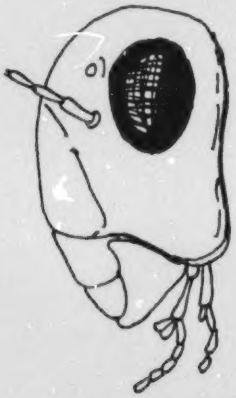
NOTE: Be sure to know whether insects are beneficial before controls are applied.

Different Metamorphoses


No Metamorphosis
(Silverfish)
Egg
Young
Adult
Gradual Metamorphosis
(Grasshopper)
Nymphs
Egg
Adult
Incomplete Metamorphosis
(Dragonfly)
Naiads
Egg
Adult
Complete Metamorphosis
Egg
Larva
Pupa
(Imported
Cabbage Butterfly)
Adult

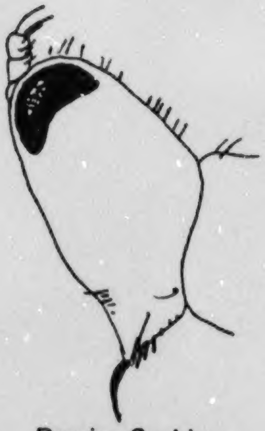
Insect Mouthparts

CHEWING MOUTHPARTS

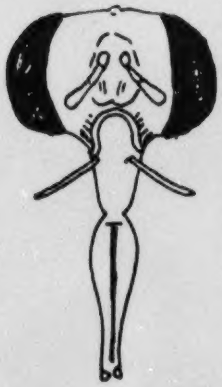


(Grasshopper)

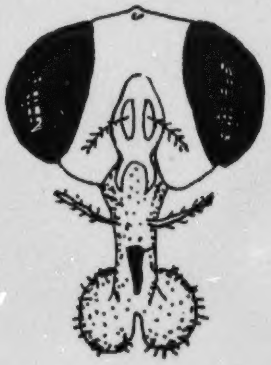
SUCKING MOUTHPARTS



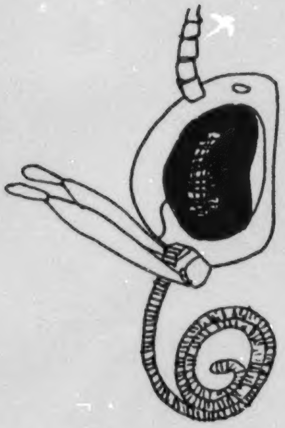
Rasping-Sucking
(Thrip)



Piercing-Sucking
(Robber Fly)



Sponging
(House Fly)



Siphoning
(Moth)

PLANT INSECTS, APPEARANCE AND CONTROL

PLANT INSECTS	APPEARANCE	CONTROL
Scale	3/16" to 1/4" dark brown oval scale. Eggs deposited in May; Crawlers hatch in June. Nymphs feed on under side of leaves until shortly before leaves fall then migrate to bark of twigs to overwinter.	Spray with Superior dormant oil (14 oz. per 11 gallon H_2O) during dormant stage. Spray with Diazinon 25% (1 qt. per 100 gallon H_2O or 2 tsp. per 1 gallon H_2O) as crawlers emerge.
Bagworms	Eggs hatch during May through August. Eggs overwinter in mother bag. Most frequent on evergreens .	Inspect weekly. Spray just as eggs are hatching. Use Diazinon 25% (see concentration above).
Fur Spotted Spider Mites	Removes sap from plant from under surface. Foliage has a speckled appearance. Mite is usually green, yellow, or red with two dark pigmented spots.	Spray with Dicofol 18.5% wettable powder (1 tablespoon per 1 gallon H_2O).

PLANT PROBLEMS AND CONTROLS

UNIT 4

ASSIGNMENT SHEET #1: Useful Information About Insects

I. **List as many harmful insects as your teacher decides.**

Name of Insect	Order Name	Type of Metamorphosis	Stage or Stages of Life Cycle That Does Damage or is Beneficial	Type of Mouthparts

II. **List as many beneficial insects as your teacher decides.**

PLANT PROBLEMS AND CONTROLS

UNIT 4

ASSIGNMENT SHEET #2: Personal Knowledge of Harmful Insects

I. List [illegible] harmful insects that you have experienced in your horticultural studies.

Name of Harmful or Beneficial Insect	Crop or Plants Damaged or Benefitted	Type of Damage or Benefit	Control Used	Prevention Used

II. List the beneficial insects that you have experienced in your horticultural studies.

PLANT PROBLEMS AND CONTROLS

UNIT 4

TEST

1. Match:

____a. Predator

____b. Pollinate

____c. Molt

____d. Parasite

____e. Habitat

____f. Metamorphosis

____g. Insecticides

____h. Pesticides

____i. Scavenger

1. An animal constituted for living off other animals, such as larvae that develop in the eggs, young, or adults of other insects.
2. A change in form during development.
3. Shed skin.
4. Generic name for all chemicals that are toxic to some stage of a plant pest's cycle.
5. An animal that lives on animals and vegetable debris.
6. The nature of the environment in which a species lives.
7. A substance that kills insects.
8. To transfer pollen from anthers to stigmas.
9. Constituted for living by preying on others.

2. Identify as True or False each of the following statements concerning insects.

____a. Average insect population per square mile is estimated to be equal to the total world population or people.

____b. Insects destroy four to fifteen billion dollars annually in the United States.

____c. Termites do no damage; are considered a "good" insect.

____d. Forest insects destroy more wood than forest fires.

____e. The Boll Weevil damages corn.

____f. One year's effort of a million workers are cancelled because of insects.

____g. Of the nearly one million insect species, only one percent are considered to be pests of man.

TEST

3. Choose from the following statements those that apply to the value of beneficial insect species.

____a. Bees, wasps, flies, butterflies, and other insects pollinate flowers that provide fruits and beauty.

____b. Important commercial products such as honey, wax, and silk are obtained from insects.

____c. Insects are not suitable for birds and fishes to feed upon.

____d. Insects are parasites or predators of damaging pests.

____e. Insects are never scavengers.

4. List five methods of controlling insects.

5. State the types of metamorphosis in insects.

6. State two facts concerning "no metamorphosis", and give one example of an insect.

7. Identify as True or False each of the following statements concerning "incomplete metamorphosis".

____a. Immature stages of these insects are found in water.

____b. Adults are found flying in the air.

____c. Stages of the young are called "naiads".

____d. Naiads slightly resemble the adult.

____e. Naiads do not molt.

____f. Mayflies and dragonflies are examples of the "incomplete metamorphosis".

8. Choose from the following statements those that apply to facts concerning "gradual metamorphosis".

____a. Newly hatched young resemble the adult in general body form.

____b. Newly hatched young have wings.

____c. After each molt, the nymphs resemble the adult more and more.

____d. Both nymphs and adults have the same type of mouth parts, food habits, and occur in the same habitat.

____e. Grasshoppers, squash bugs, and aphids are examples of gradual metamorphosis.

TEST

9. Select from the following statements those that apply to facts concerning "complete metamorphosis".

____a. Most common type of metamorphosis.

____b. Includes four developmental stages - egg, larva, pupa, and adult.

____c. The larva is the same form as the adult.

____d. The larva molts several times.

____e. All larvae have chewing or modified chewing mouth parts.

____f. The larva changes to the pupa.

____g. The pupa is an active stage where drastic changes take place.

____h. The pupa feeds in huge quantities.

____i. The pupa is a worm-like body that changes into a moth, beetle, or bee.

____j. The adult emerges from the pupal stage.

10. Identify as True or False each of the following statements concerning life cycles of insects.

____a. The cycle is divided into two seasons - dormant and active.

____b. Overwintering stage of the insect life cycle is not important.

____c. Life cycles of insects can be broken by burning trash piles and clumps of weeds in the winter.

____d. Insects only have one life cycle within a crop growing season.

____e. Effective control of insects is to know at what stage the insect is doing damage.

____f. In order to destroy the insect's life cycle, follow the directions on the label of the pesticide.

____g. Do not deviate from the manufacturer's instruction.

11. Name two methods of reducing damage by insects.

12. List three methods of reducing damage by insects through prevention.

TEST

13. Choose from the following statements those that apply to methods of reducing damage by insects through controls.

____a. Correctly identify the insect, its stage of development, and the damage it does.

____b. Know the life cycle habits of the harmful insects.

____c. It is not necessary to know the "weak link" in the life cycle of an insect.

____d. Know how to prevent insect infestations.

____e. Know how to select the correct insecticide.

____f. Use approved and safe methods when applying insecticides.

____g. Enable predator insects to control pests.

PLANT PROBLEMS AND CONTROLS

UNIT 5

WEEDS

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to define terms that pertain to weeds; to state facts pertaining to weeds, methods of control, and types of weeds. This objective will be considered achieved upon attainment of a score of at least eighty-five percent on the test.

SPECIFIC OBJECTIVE

After completion of this unit, students will be able to:

1. Match terms pertaining to weeds and weed control with definitions.
2. List two facts about weeds.
3. Name two basic methods of weed control.
4. State three mechanical methods of destroying weeds.
5. List at least three tools or machines available for mechanical weed control
6. Identify as true or false given statements concerning chemical destruction of weeds.
7. List three factors upon which a weed-control program depends.
8. Name two types of compounds used in a herbicide weed-control program.
9. Choose from given statements those that apply to nonselective herbicide compounds.
10. Select from given statements those that apply to selective herbicide compounds.
11. Identify as true or false given statements concerning steps in pre-emergence weed control treatments.
12. Identify as true or false given statements concerning steps in post-emergence weed control treatments.
13. Name two types of noxious weeds.
14. Identify the common poisonous weeds. (Supplemental Sheets)

PLANT PROBLEMS AND CONTROLS

UNIT 4

INFORMATION SHEET

I. Terms and Definitions

   A. Herbicides - Substances that kill vegetation.

   B. Spore - A single cell, which when freed, develops into a new plant.

   C. Toxic - Poisonous.

   D. Dichondra - A broadleaf ground cover.

   E. Photoplasm - The physicochemical basis of lining matter.

   F. Monocot - A type of seed with one seed leaf or cotyledon; Example: grasses - short for monocotyledon.

   G. Dicot - A type of seed with two seed leaves or cotyledons; Example: bean- short for dicotyledon.

   H. Noxious weed - A plant that causes injury to a crop plant.

   I. Weed - Any plant that is growing where it is not wanted.

II. Facts About Weeds

   A. Weeds compete with garden plants for water, nutrients, and space.

   B. Weeds harbor insects and sometimes spores of plant diseases.

III. Basic Methods of Weed Control

   A. Mechanical destruction

   B. Chemical destruction

IV. Mechanical Methods of Destroying Weeds

   A. Hand pulling - Used when weeds are growing among choice, shallow-rooted plants.

   B. Hoeing and Cultivating - Used for destruction of weeds in relatively large areas.

   C. Flaming - Used before weeds have developed fully.

V. Tools and Machines Used for Mechanical Destruction of Weeds

   A. Common garden hoe - Used for row crops.

   B. Cultivating forks (different sizes) - Used for little garden plants and shrubs.

   C. Scuffle hoes (flat-bladed, disk type, or U-shaped) - Used in close quarters or under spreading plants.

   D. Rotary tilling and disking - Used in larger gardens, orchards, vacant lots, or farms.

INFORMATION SHEET

1. Especially effective where there are no summer rains to germinate late weed crop .
2. They knock down weeds and incorporate them into the soil where they decay and form humus .

E. Weed burners - Used for flaming .

F. Mulch - Used to prevent weed growth .

VI. Chemical Destruction of Weeds

A. Used to reduce labor cost .

B. Sprayer should be clearly marked as to content and used only for weed killing .

C. Weed killers called herbicides are toxic.

D. Chemical can selectively kill germinating or recently germinated weeds in turf .

E. With chemicals there is a risk of damaging other desired forms of plant life .

F. With chemicals there is a likelihood that they won't work.

G. Timing is of critical importance for each of these materials.

VII. What a Program of Weed Control Depends Upon

A. Frequency with which crops of weeds become established.

B. Amount of top and root growth of the crop plant .

C. Soil type .

VIII. Types of Compounds Used in a Weed-Control Herbicide Program

A. Compounds which are nonselective in action .

B. Compounds which are selective in action .

IX. Nonselective Herbicide Compounds for Weed Control .

A. Are toxic to all plants .

B. Examples of non-selective h[illegible] that kill the whole plant; lead arsenate, calcium arsen[illegible] [illegible]rax, sodium chloride, and ammonium suffamate, called Ammate .

C. Examples of non-selective herbicides that defoliate (destroy top growth): paraquat .

D. Advantages and Disadvantages: One compound may be more effective and desirable for use under one set of conditions, and another compound may be more effective and desirable under another .

X. Selective Herbidice Compounds for Weed Control (See TM 1)

INFORMATION SHEET

A. Are toxic to certain kinds of plants and do very little, if any, damage to other kinds.

   1. Toxic - Kills the protoplasm by direct chemical action. Example: Ansar 529.

   2. Growth regulators - Induce an abnormal development of certain tissues. Example: 2, 4-D.

XI. Steps in Pre-emergence Weed Control Treatments (See TM 1)

   A. Prepare the land to receive the seed.

   B. The weed seed germinates, absorbs the herbicide, and dies.

   C. The crop seed is planted and the herbicide is applied.

   D. Advantage: Herbicide is applied when the weed seedlings are very susceptible to injury .

   E. Disadvantage: Heavy rains may leach the herbicide to the vicinity of the seed, and thus could retard or prevent germination of the crop seed. Also, most perennial weeds are not susceptible to pre-emergence herbicides.

XII. Steps in Post-emergence Weed Control Treatments (See TM 1)

   A. Crop seed is planted immediately after the land is prepared.

   B. Herbicide applied when the crop plant is established.

   C. Advantage: Possible injury to the germinating seeds is avoided.

   D. Disadvantage: Mature weed plants may be quite resistant to the effects of the herbicide since mature tissues are more resistant than immature tissues. Also, there may be some damage to future crops from herbicide residue.

XIII. Types of Noxious Weeds (See TM 2 and TM 3)

   A. Grassy Weeds (monocots)

      1. Examples: Barnyard grass, crab grass, foxtail, goose grass, witch grass, bent grass, coarse fescue, quack grass, rye grass, timothy .

   B. Broadleaf Weeds (Dicots) (See TM 4 and TM 5)

      1. Viney type: Clover, oxalis, bindweed.

      2. Rosette type: plantain, dandelion.

INFORMATION SHEET

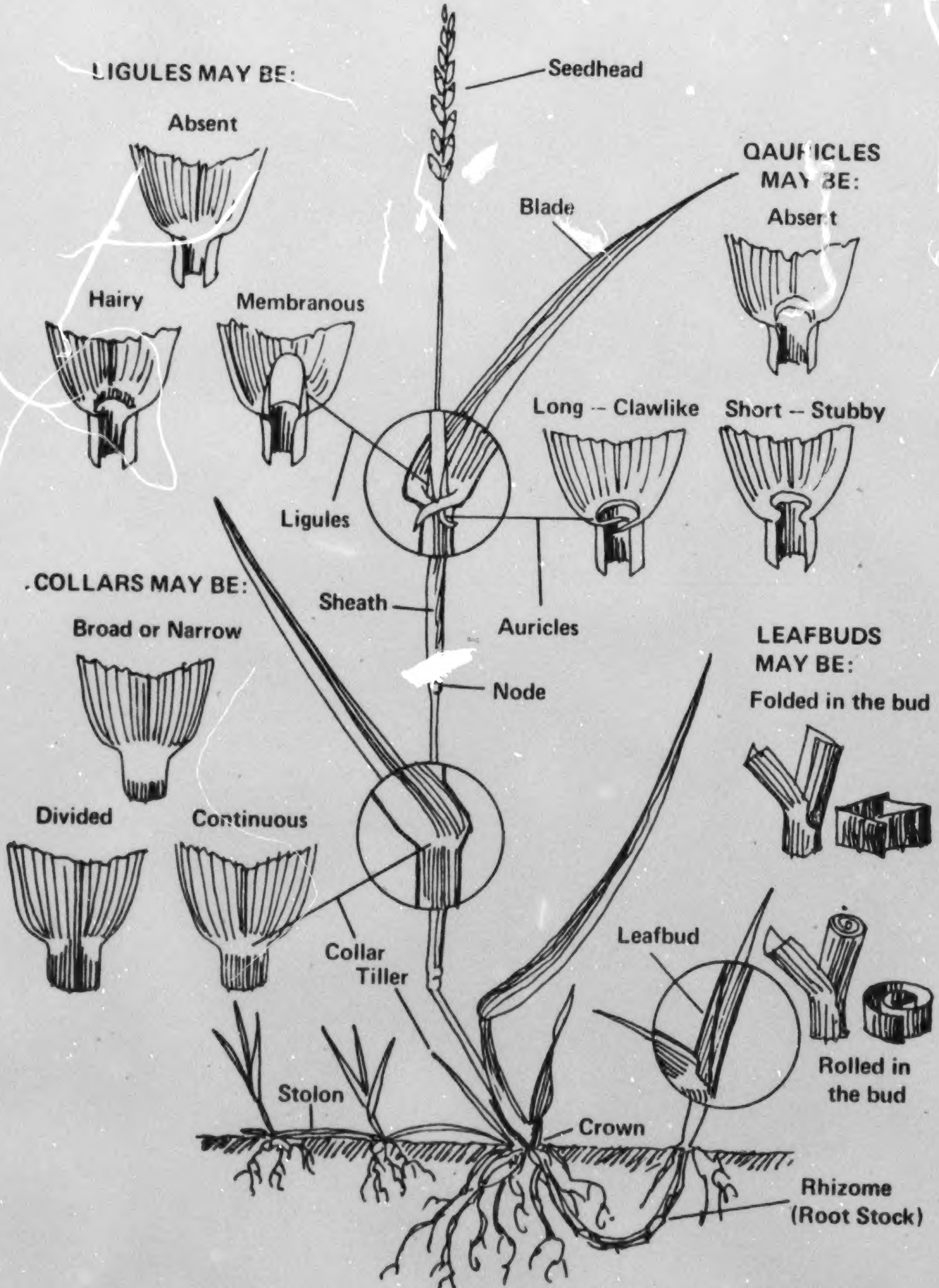
XIV. Kinds of Poisonous Weeds. (See TM 6)

Plant	Toxic Part	Symptoms
1. Buttercup	All parts	Irritant juice may severely injure the digestive system .
2. Nightshade	All parts	Fatal - Intense digestive disturbance and nervous symptoms.
3. Poison Hemlock	All parts	Fatal - Resembles a large wild carrot.
4. Jimson Weed (thorn apple)	All parts	Abnormal thirst, distorted sight, delerium coma.

Examples of Selective Herbicides

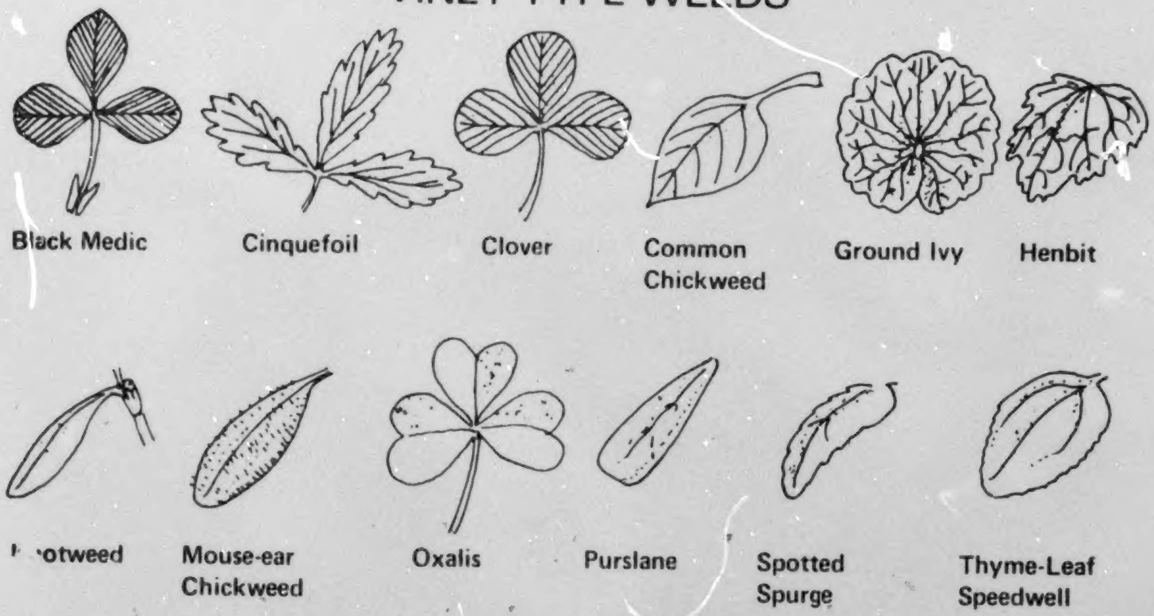
Type of Compound	Common or Trade Name	Crop	Recommended type of Application	Weeds Not Usually Controlled
Toxic Compounds:				
Dinitro	DNPB	Snap bean	Pre-emergence	Late weeds
		Lima bean	Pre-emergence	
		Garden pea	Pre-emergence	
		Sweet corn	Pre-emergence	
		Potato	Pre-emergence	
Carbamates	Chloro IPC	Onion	Pre- and Post-emergence	
		Spinach	Pre-emergence	
		Southern pea	Pre-emergence	
		Sweet potato	Post-emergence	
Petroleum Products	Stoddards	Carrot	Post-emergence	Ragweed
Cyanates	Cyanamid	Onion	Pre-emergence	Grasses
Substitute Ureas	CMU	Asparagus	Before and after harvest	Lamb's quarters Milkweed
Other	NPA or Analap	Vine crops	Pre-emergence	
Growth Regulators:				
Phenoxyacids	2, 4-D	Gladiolus	Post-emergence	Most grasses
		Lawns	Post-emergence	
		Sweet corn	Post-emergence	

Parts of a Grass Plant

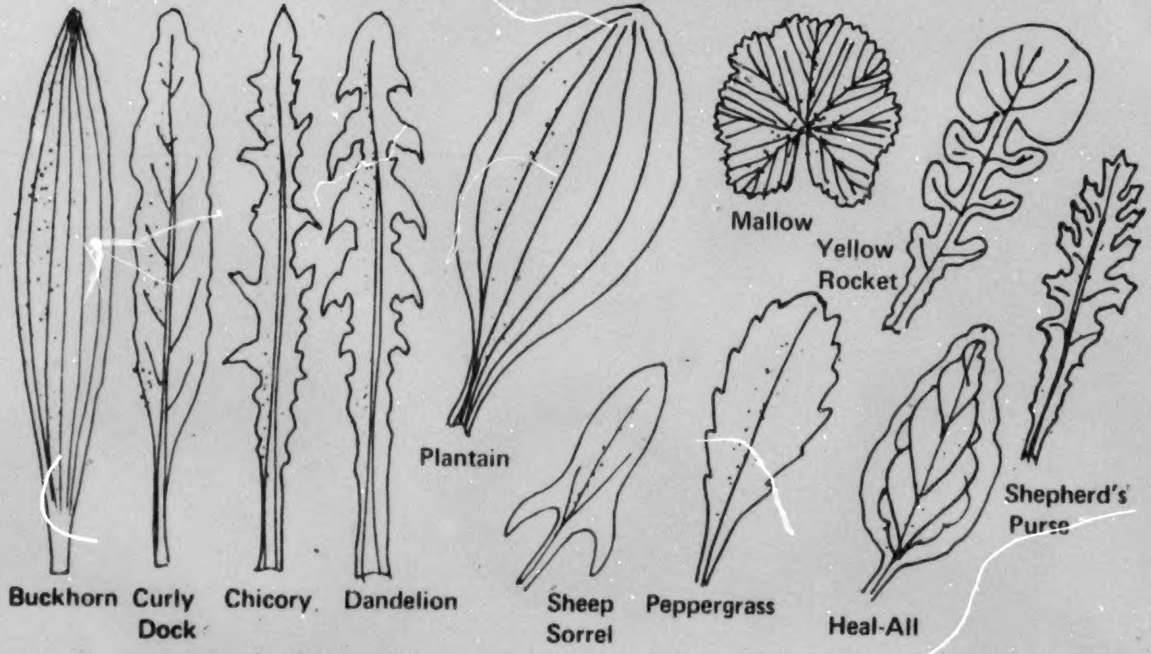

LIGULES MAY BE:
Absent
Hairy
Membranous
Seedhead
QAURICLES MAY BE:
Absent
Blade
Long -- Clawlike
Short -- Stubby
Ligules
COLLARS MAY BE:
Broad or Narrow
Sheath
Auricles
Node
LEAFBUDS MAY BE:
Folded in the bud
Divided
Continuous
Collar
Tiller
Leafbud
Rolled in the bud
Stolon
Crown
Rhizome (Root Stock)

Broadleaf Weeds

VINEY TYPE WEEDS


Black Medic
Cinquefoil
Clover
Common Chickweed
Ground Ivy
Henbit
Knotweed
Mouse-ear Chickweed
Oxalis
Purslane
Spotted Spurge
Thyme-Leaf Speedwell

ROSETTE TYPE WEEDS


Mallow
Yellow Rocket
Plantain
Shepherd's Purse
Buckhorn
Curly Dock
Chicory
Dandelion
Sheep Sorrel
Peppergrass
Heal-All

Some Broadleaf Weeds and 2, 4-D Control

WEEDS	LIFE SPAN	2, 4-D CONTROL
Bindweed	Perennial	Repeat
Black Medic	Annual	One application
Buckhorn	Perennial	One application
Chicory	Perennial	Repeat
Common Chickweed	Annual	One application
Mouse-Ear Chickweed	Perennial	One application
Clover	Perennial	One application
Dandelion	Perennial	One application
Curly Dock	Perennial	One application
Ground Ivy	Perennial	One application
Heal-All	Perennial	One application
Henbit	Annual	One application
Knotweed	Annual	One application
Lambsquarters	Annual	One application
Mallow	Perennial	Repeat
Mustard	Perennial	
Peppergrass	Annual	One application
Pigweed	Annual	One application
Plantain	Perennial	One application
Purslane	Annual	One application
Ragweed	Annual	Repeat
Sheep Sorrel	Perennial	One application
Shepher's Purse	Annual	One application
Smartweed	Annual	Repeat
Spotted Spurge	Annual	No selective control
Texas Blueweed	Perennial	Repeat
Thistle (Canada)	Perennial	Repeat
Yellow Rocket	Biennial	One application

Check with instructor on control of narrow-leaf (monocot) weeds.

PLANT PROBLEMS AND CONTROLS

UNIT 5

ASSIGNMENT SHEET #1: Garden Tools

I. Demonstrate to the instructor's satisfaction the proper use of garden tools.

PLANT PROBLEMS AND CONTROLS

UNIT 2

JOB SHEET #1: Hand Sprayer Calibration

I. Equipment and materials needed

- A. Hand sprayer
- B. Water

II. Procedure

- A. Mark off an area 10' x 10' (100 square feet).
- B. Fill sprayer with water to the 3 gallon mark and spray the area using the same pressure and speed used for spraying weeds.
- C. Refill sprayer, measuring accurately the amount of water required to refill to the original level.
- D. Determine per acre rate of spray delivery from the table below:

TABLE I

LIQUID

Nozzle Discharge Per 100 Sq. Ft.	Amount Of Spray Per Acre	Type of Application	Nozzle Discharge Per 100 Sq. Ft.	Amount Of Spray Per Acre
1/4 Pint	14 Gallons	Low Volume	1/2 Pint	27 Gallons
1 Pint	55 Gallons	Medium Volume	1 1/2 Pints	82 Gallons
1 Quart	110 Gallons	High Volume	1 1/2 Quarts	165 Gallons
2 Quarts	220 Gallons	High Volume	4 Quarts	440 Gallons

Spraying at the rate of 1 quart per 100 square feet (110 gallons per acre), the following table shows the approximate amounts of products to use in 1 gallon of water for various per acre rates of application.

TABLE II

DRY

(1)	3 lbs// A	5 lbs./ A	10 lbs./ A	20 lbs./ A
(2)	1/2 oz./ Gal.	3/4 oz./ Gal.	1 1/2 oz./ Gal.	3 oz./ Gal.

(1) Rate per acre.

(2) Amount of product to use per gallon of spray (dilute with water).

PLANT PROBLEMS AND CONTROLS

UNIT 5

SUPPLEMENTAL SHEETT #1 - 4: COMMON POISONOUS PLANTS

HOUSE PLANTS

PLANT	TOXIC PART	SYMPTOMS
Hyacinth Narcissus Daffodil	Bulbs	Nausea, vomiting, diarrhea. May be fatal.
Oleander	Leaves, Branches	Extremely poisonous. Affects the heart, produces severe digestive upset and has caused death.
Poinsettia	Leaves	Fatal. One leaf can kill a child.
Dieffenbachia	All parts	Intense burning and irritation of the mouth and tongue. Death can occur if base of the tongue swells enough to block the air passage of the throat.
Rosary pea Castor bean	Seeds	Fatal. A single rosary pea seed has caused death. One or two castor bean seeds are near the lethal dose for adult.
Mistletoe	Berries	Fatal. Both children and adults have died from eating the berries.

FLOWER GARDEN PLANTS

PLANT	TOXIC PART	SYMPTOMS
Larkspur	Young plant, Seeds	Digestive upset, nervous excitement, depression. May be fatal.
Monkshood	Fleshy roots	Digestive upset and nervous excitement.
Autumn crocus, Star-of-Bethlehem	Bulbs	Vomiting and nervous excitement.
Lily-of-the-valley	Leaves, Flowers	Irregular heart beat and pulse, usually accompanied by digestive upset and mental confusion.
Iris	Underground stems	Severe, but not usually serious, digestive upset.

SUPPLEMENTAL SHEETS #1 - #4: COMMON POISONOUS PLANTS

Foxglove	Leaves	One of the sources of the drug digitalis, used to stimulate the heart. In large amounts, it could cause dangersously irregular heartbeat and pulse, usually digestive and mental confusion. May be fatal.
Bleeding heart, (Dutchman's breeches)	Foliage, Roots	May be poisonous in large amounts. Has proved fatal to cattle.

VEGETABLE GARDEN PLANTS

Rhubarb	Leaf blade	Fatal. Large amounts of raw or cooked leaves can cause convulsions, coma, followed rapidly by death.

ORNAMENTAL PLANTS

Daphne	Berries	Fatal. A few berries can kill a child.
Wisteria	Seeds, Pods	Many children are poisoned by this plant.
Golden chain	Beanlike capsules in which the seeds are suspended	Severe poisoning. Excitement, Staggering, convulsions, and coma. May be fatal.
Laurels	All parts	Fatal. Produces nausea and vomiting, depression, difficult breathing, prostration, and coma.
Lantana camara	Green berries	Fatal. Affects lungs, kidneys, heart, and nervous system. Grows in the southern U.S. and in modern climates.
Jessamine	Berries	Fatal. Digestive disturbance and nervous symptoms.
Yew	Berries Foliage	Fatal. Foliage more toxic than berries. Death is usually sudden without warning symptoms.

SUPPLEMENTAL SHEETS #1 - #4: COMMON POISONOUS PLANTS

Wild and cultivated cherries	Twigs, Foliage	Fatal. Contains a compound that releases cyanide when eaten. Gasping, excitement, and prostration are common symptons that often appear minutes.
Oaks	Foliage, Acorns	Affects kidneys gradually. Symptons appear only after several days or weeks. Takes a large amount for poisoning. Children should not be allowed to chew on acorns.
Elderberry	Shoots, leaves, Bark	Children have been poisoned by using pieces of the pithy stems for blowguns. Nausea and digestive upset.
Black Locust	Bark, Sprouts, Foliage	Children have suffered nausea, weakness and depression after chewing the bark and seeds.

PLANTS IN WOODED AREAS

Jack-in-the-pulpit	All parts, especially roots	Like dumb cane, contains small needlelike crystals of calcium oxalate that cause intense irritation and burning of the mouth and tongue.
Moonseed	Berries	Blue, purple color, resembling wild grapes. Contains a single seed. (True wild grapes contain several small seeds.) May be fatal.
Mayapple	Apple, foliage, roots	Contains at least 16 active toxic principles, primarily in the roots. Children often eat the apple with no ill effects, but several apples may cause diarrhea.

PLANTS IN SWAMPS OR MOIST AREAS

Water hemlock	All parts	Fatal. Violent and painful convulsions. A number of people have died from hemlock.

SUPPLEMENTAL SHEETS #1 - 4: COMMON POISONOUS PLANTS

PLANTS IN FIELDS

Buttercup	All parts	Irritant juices may severely injure the digestive system.
Nightshade	All parts, especially the unripe berry	Fatal, Intense digestive disturbances and nervous systems.
Poison hemlock	All parts	Fatal. Resembles a large wild carrot. Used in ancient Greece to kill condemned prisoners.
Jimson weed (thorn apple)	All parts	Abnormal thirst, distorted sight, delirium, incoherence, and coma. Common cause of poisoning. Has proven fatal.

PLANT PROBLEMS AND CONTROLS

UNIT 5

TEST

1. Match:

_____a. Dichondra
_____b. Monocot
_____c. Herbicides
_____d. Spore
_____e. Dicot
_____f. Toxic
_____g. Noxious Weed
_____h. Protoplasm
_____i. Weed

1. Any plant growing where it is not wanted.
2. A minute body that develops into a new individual.
3. Poisonous.
4. A substance that kills vegetation.
5. A broadleaf ground cover.
6. A type of seed with one seed leaf or cotyledon.
7. A plant that causes injury to a crop plant.
8. A type of seed with two seed leaves or cotyledon.
9. The physical chemical basis of living matter.

2. List two facts about weeds.

3. Name two basic methods of weed control.

4. State three mechanical methods of destroying weeds.

5. List at least three tools or machines available for mechanical weed control.

6. Identify as True or False each of the following statements concerning chemical destruction of weeds.

_____a. Used to reduce labor cost.
_____b. Sprayer should be clearly marked as to content and used only for weed killing (Unit 2).
_____c. Chemicals do not damage the crop plant.
_____d. Sometimes chemicals don't work.
_____e. Timing of application is not important.

7. List three facts that a program of weed control depends on.

8. Name two types of compounds used in a weed-control herbicide program.

9. Choose from the following statements those that apply to nonselective herbicide compounds.

_____a. Are toxic to all plants.

TEST

_____b. One compound may be more effective and desirable under one set of conditions and another compound may be more effective and desirable under another.

_____c. They do not kill plants.

_____d. Some examples of herbicides that kill the whole plant are lead arsenate, calcium arsenate, and sodium chloride.

_____e. An example that defoliates only is Paraquat.

10. Choose from the following statements those that apply to selective herbicide compounds.

_____a. Are toxic to certain kinds of plants.

_____b. Do very little damage to some plants.

_____c. They kill the protoplasm by direct chemical action.

_____d. They do not induce abnormal growth in the plant tissue.

11. Select as True or False each of the following statements concerning pre-emergence weed control treatments.

_____a. Used in the fall of the year.

_____b. Used before the seedling plant emerges.

_____c. The weed seed germinates before the seed is planted.

_____d. The chemical is applied as the seed is planted.

_____e. The weed seedling is not susceptible to injury.

_____f. Heavy rains may leach the chemical to the vicinity of the crop seed and retard its growth.

12. Identify as True or False each of the following statements concerning post-emergence weed control treatments.

_____a. Used after the seedling of the crop plant has emerged.

_____b. Seed is planted as soon as the land is prepared.

_____c. Chemical is applied when the crop plant is in the seedling stage.

_____d. Crop plant germinating seedling can avoid being injured.

_____e. Weed plants do not become resistant to the chemicals used.

13. List two types of noxious weeds.

14. List four types of poisonous weeds.

HORTICULTURE MECHANICS

UNIT 1

INTRODUCTION TO PLUMBING

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to identify pipe and pipe fittings, and be able to demonstrate the proper procedures for threading, reaming, and cutting pipe. These skills will be adapted to the student's home, farm, and community. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define five terms associated with plumbing.
2. Name and give the use of five different kinds of pipe.
3. Identify ten common pipe fittings.
4. List two reasons for using threading compounds.
5. Identify five tools used in plumbing.
6. Name four reasons for using cutting oil.
7. List five common sizes of pipe used in plumbing.
8. Distinguish between bolt and pipe threads.
9. State the procedure for measuring bolts and pipe to determine diameter.
10. List the five classes of plastic pipe.
11. Demonstrate the proper procedures for performing the following jobs:
    a. Cutting pipe
    b. Reaming pipe
    c. Threading pipe
    d. Soldering pipe (copper)
    e. Connecting PVC pipe
    f. Constructing a mist system

HORTICULTURE MECHANICS

UNIT 1

INFORMATION SHEET

I. Terms and Definitions

A. Plumbing - The piping and pipe attachments used to carry water into buildings and to drain away sewage and waste.

B. Soil pipes - The large pipes used to carry sewage.

C. Fittings - The pieces used to join pipe, to provide openings in pipes, and to change the direction of pipes.

D. Trap - A water-sealed bend or Chamber in a waste pipe.

E. House drain - A pipe which carries all the sewage from the house.

F. Stack - A soil, waste, or ventilating pipe.

G. Fixtures - The appliances connected to the plumbing.

H. Septic tank - A tank which receives all the sewage piped into it and allows the process of sewage treatment to take place.

I. Lateral pipe - A pipe which drains the liquid from the septic tank to the soil.

II. Kinds of Pipe

A. Black - Used for natural and L.P. gas, oil, and air lines.

B. Galvanized - Used for water lines.

C. Copper tubing - Used in water, refrigeration, and waste systems.

D. Cast iron - Used in sewage systems.

E. Brass or lead - Used for traps and drains.

F. Plastic - Used in water systems.

G. PVC - Used in a water or sewage system (plastic pipe).

H. Soil - Used in a sewage system (cast iron pipe).

III. Pipe Fittings (Transparencies 1 and 3)

A. Bushing

B. 90°Elbow

C. Coupling

VI. Reasons for Using Cutting Oil on Tools.

A. Cuts smoother

B. Cuts easier

C. Lasts longer

D. Removes burrs from dies

INFORMATION SHEET

VII. Common Sizes of Pipe Used in Plumbing

- A. 1/4"
- B. 1/2"
- C. 3/4"
- D. 1"
- E. 1 1/4"

VIII. Threads

- A. Pipe - Thread 1/16" per inch (NOTE: Pipe has standard threads)
- B. Bolt - Straight threads
  - 1. National coarse
  - 2. National fine

IX. Diameter Measurements

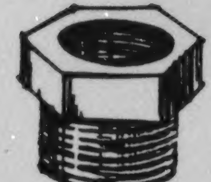
- A. Pipe - Inside
- B. Bolt - Outside

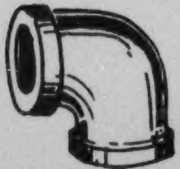
X. Five Classes of Plastic Pipe

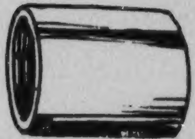
- A. Acrylonitrite - Butadiene Styrene (ABS)
- B. Polybutylene (PB)
- C. Chlorinated Polyvinyl Chloride (CPVC)
- D. Polyvinyl Chloride (PVC)
- E. Polyethylene (PE)

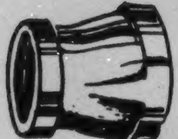
(D & E - Most commonly available in Kansas)

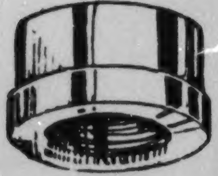
Pipe Fittings

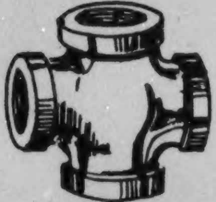

A. **Bushing**

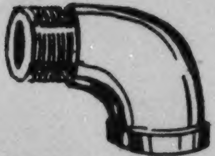

B. **90° Elbow**

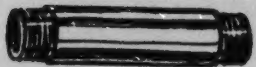

C. **Coupling**

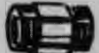

D. **Bell Reducer**

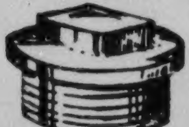

E. **Cap**

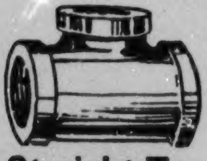

F. **Straight Cross**

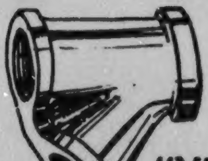

G. **90° Street Elbow**

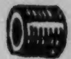

H. LONG NIPPLE

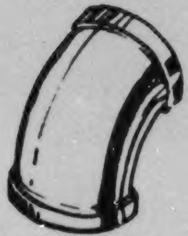

I. SHORT NIPPLE

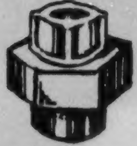

J. **Plug**

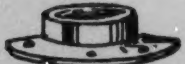

K. **Straight Tee**


L. **"Y"**


M. CLOSE NIPPLE


N. **45° Elbow**

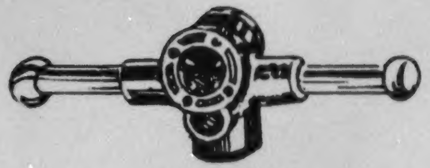

O. **Union**


P. **Floor Flange**

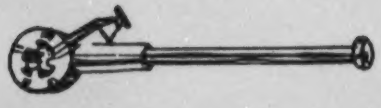
TM 1

HORTII SH U1-6

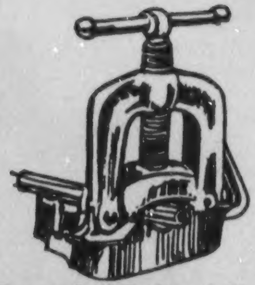
Plumbing Tools



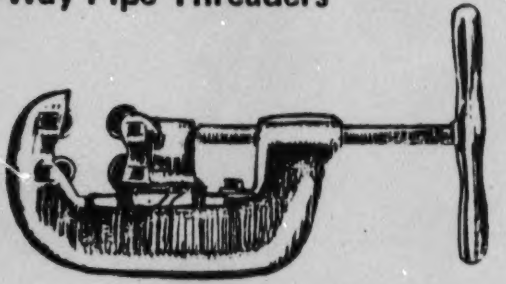
3-Way Pipe Threaders



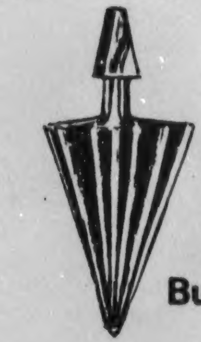
Small Ratchet Threaders



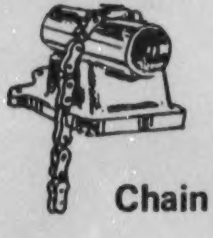
Bench Yoke Vises



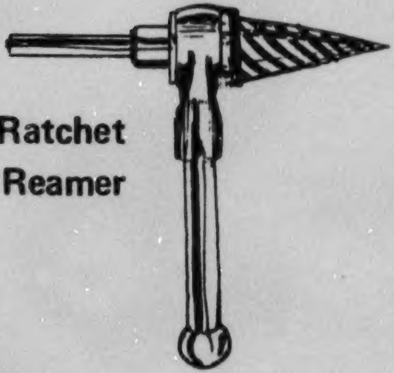
Pipe Cutter



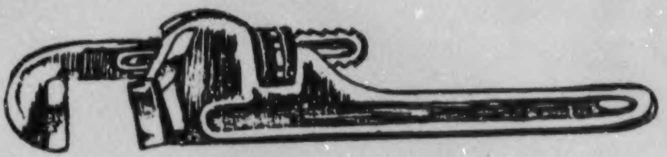
Burr Reamer



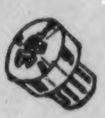
Chain Vises



Spiral Ratchet Pipe Reamer



Pipe Wrench

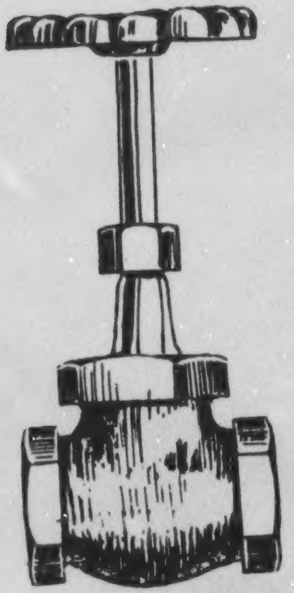


Die

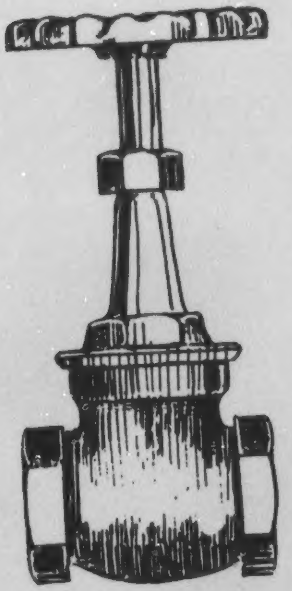
TM 2

HORTII SH UL-7

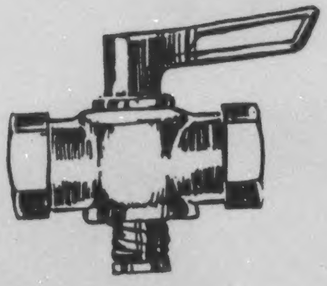
Types of Valves



Globe Valve



Gate Valve



Gas Stop

HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #1: Cutting Pipe (Black or Galvanized)

Demonstrate your ability to cut pipe according to the instructions and procedures given. Cut two pieces of 3/4 inch pipe eight inches long. Cut one piece of 1/2 inch pipe eight inches long. Turn in to the instructor for grade.

I. Tools Needed:

- A. Vise
- B. Taper triangular file
- C. Ruler or steel tape
- D. Pipe cutter

II. Materials Needed:

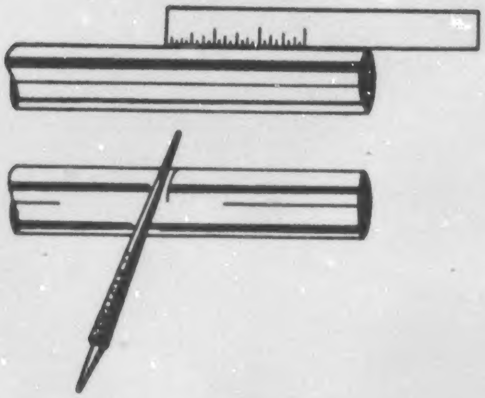
- A. Two feet of 3/4 inch pipe
- B. One foot of 1/2 inch pipe

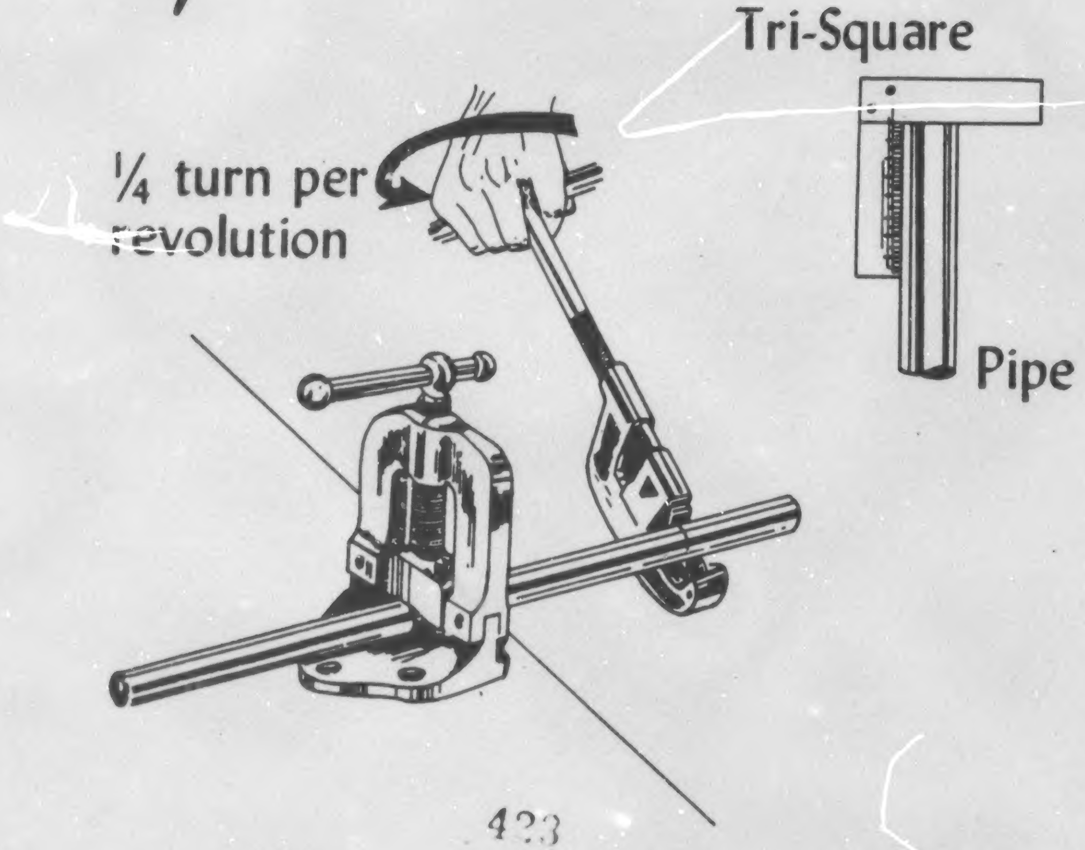
III. Procedures:

- A. Measure length of pipe desired
- B. Mark desired length with tapered triangular file
- C. Fasten pipe in vise so mark is at least four inches from vise
- D. Place pipe cutter on mark
- E. Tighten pipe cutter by screwing in handle until cutting wheel is snug against pipe
- F. Hold handle perpendicular to the pipe and tighten handle until cutting wheel penetrates metal
- G. Turn pipe cutter 1/4 turn per revolution until pipe is cut off
- H. Check cut for squareness

JOB SHEET #1: Cutting Pipe (Black or Galvanized)

IV. Diagram of procedure:




Tri-Square
¼ turn per revolution
Pipe

HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #2: Reaming Pipe

Demonstrate your ability to ream pipe according to the instructions and procedures given. Ream two pieces of 3/4 inch pipe eight inches long. Ream one piece of 1/2 inch pipe eight inches long. Turn in to the instructor for grade.

I. Tools Needed:

   A. Vise

   B. Burr reamer

   C. Carpenter brace

II. Materials Needed:

   A. Two pieces of 3/4 inch pipe eight inches long

   B. One piece of 1/2 inch pipe eight inches long

III. Procedures:

   A. Fasten pipe in vise allowing four inches to extend from vise

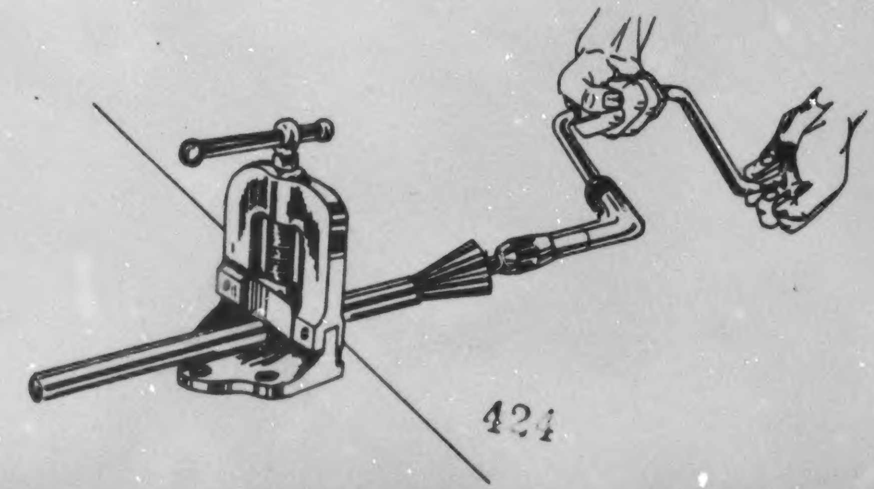
   B. Place reamer in line with pipe

   C. Turn reamer clockwise until inside burr is off

   D. Remove reamer and check with finger to see if burr is cut away

(NOTE: Do not cut more than necessary as first threads on pipe will be weakened.)

IV. Diagram of procedure:



HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #3: Threading Pipe

Demonstrate your ability to thread pipe according to the instructions and procedures given. Thread the pieces of pipe that were used in Job Sheets #1 and #2. Thread pipe on both ends and turn in to the instructor for grade.

I. Tools Needed:

- A. Vise
- B. Flat file
- C. 3/4" and 1/2" dies
- D. Die stock
- E. Cutting oil
- F. Wire brush

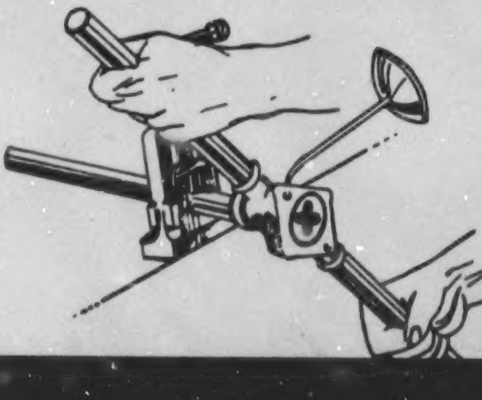
II. Materials Needed:

- A. Two pieces of 3/4 inch pipe eight inches long
- B. One piece of 1/2 inch pipe eight inches long

III. Procedures:

- A. Place pipe in vise allowing six inches to extend from vise
- B. File off any outside burr that may be on pipe end caused by cutting pipe
- C. Place proper size die in stock
- D. Place pressure against die holder with palm of hand, turn clockwise until die starts cutting threads.
- E. Use cutting oil on the threading area at all times
- F. Continue threading until one thread is past the die
- G. Back off die and inspect threads
- H. Use wire brush and clean threads

IV. Diagram of procedure:



HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #4: Soldering Copper Pipe

Demonstrate your ability to solder copper pipe according to the instructions and procedures given. Cut two pieces of 1/2 inch pipe eight inches long. Connect them together using a copper coupling, sealing the joint. Turn into the instructor for a grade.

I. Tools Needed:

- A. Pipe Vise
- B. Ruler or steel tape
- C. Taper triangular file
- D. Pipe cutter
- E. Burr reamer
- F. Carpenter brace
- G. Blow torch

II. Materials Needed:

- A. Two feet of 1/2 inch copper pipe
- B. One 1/2 inch copper coupling
- C. One piece emery cloth
- D. Solder (50-50)
- E. Soldering flux (acid, rosin, sal ammoniac)

III. Procedures:

- A. Cut two eight inch pieces of 1/2 inch copper pipe as in Job Sheet #1.
- B. Ream the pipes as in Job Sheet #2.

  (NOTE: Be careful. Copper pipe will crush easily. Tighten vise only enough to secure pipe.)
- C. Use emery cloth to roughen the outside of the pipe, and the inside of the coupling.
- D. Apply a thin coating of flux to the surface of the pipes, where the metals will come in contact.

  (NOTE: A paste flux is handy because spilling rarely occurs. You don't have to close the lid after each joint is soldered as you would with an acid flux.)
- E. Insert both pipes into the coupling, making sure the ends inserted are the prepared ones.
- F. Place one end of a pipe in the pipe vise.
- G. Heat the joint with the blow torch until the flux boils, or until the solder melts when touched to the copper.

JOB SHEET #4: Soldering Copper Pipe

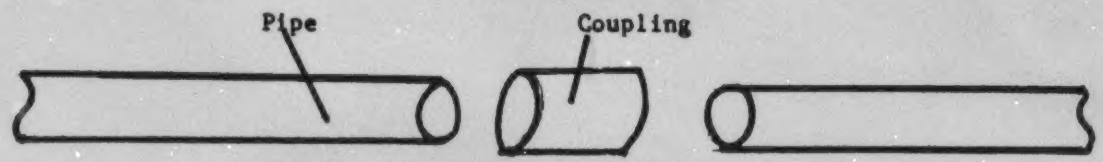
> (Note: When flux boils, remove heat, then touch the solder to the seam of the joint. If solder doesn't melt readily, apply more heat. Don't melt solder with the flame.)

H. Make sure solder flows entirely around the seam, sealing the joint. If the procedures are done correctly the solder will be pulled into the joint.

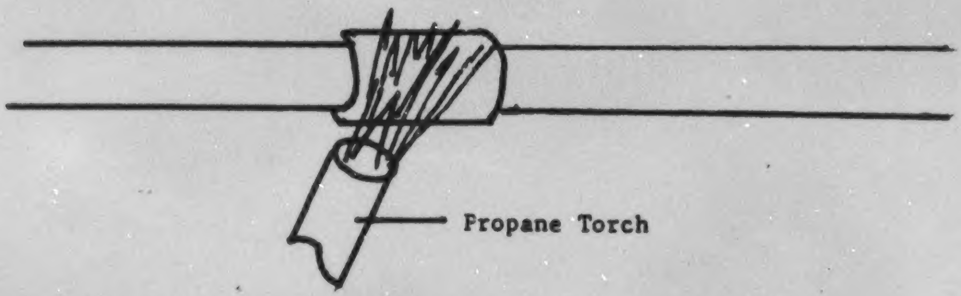
FOR SAFETY'S SAKE

Blow torch flame is extremely hot. Be sure you do not direct the flame at anyone.

IV. Diagram of procedures:



Roughen the outside of the pipe and inside of the coupling, then smear flux on the roughened surfaces.



Insert ends of pipes into coupling and heat with blowtorch flame. Then remove flame, and apply solder.

HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #5: Connecting Plastic Pipe (PVC)

Demonstrate your ability to splice plastic pipe according to instructions and procedures given. Cut two four inch pieces of 1/2 inch plastic pipe (PVC - Polyvinyl Chloride). Splice them together using a PVC coupling. Hand into the instructor for a grade.

I. Tools Needed:

- A. Hacksaw
- B. Ruler or steel tape

II. Materials Needed:

- A. Eight inches of 1/2 inch PVC pipe
- B. One 1/2 inch PVC coupling
- C. One can of PVC solvent

III. Procedures:

- A. Mark the eight inch piece of 1/2 inch PVC pipe at the desired length (two 4 inch pieces)
- B. Cut with a hacksaw
- C. Be sure PVC pipe is clean
- D. Apply solvent to one end of each piece of pipe, and the inside of the coupling.
- E. Insert the ends of the pipe into the coupling.

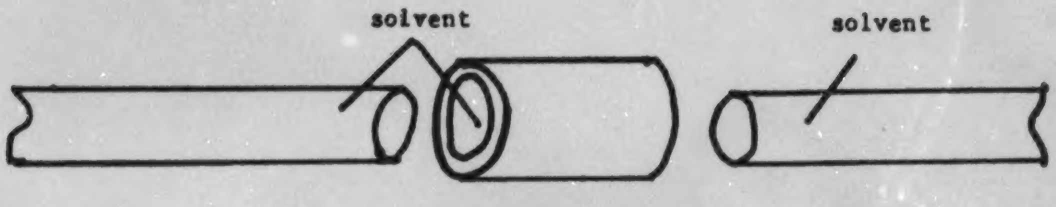
  (NOTE: Insertion of pipe into coupling must be done quickly to avoid the "welding" of coupling and pipe before the pipe is inserted completely.)
- F. Follow directions on solvent can in order to allow proper curing time for the joint.

FOR SAFETY'S SAKE

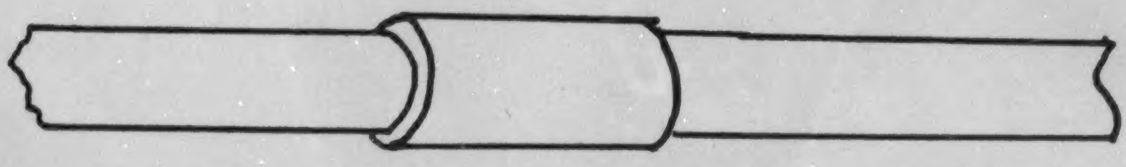
Follow label directions when using the PVC solvent, to avoid safety hazards.

JOB SHEET #5: Connecting Plastic Pipe (PVC)

IV. Diagram of Procedure:



Apply solvent to ends of pipe and inside coupling.



Insert pipes into coupling as quickly and completely as possible.

HORTICULTURE MECHANICS

UNIT 1

JOB SHEET #6: Constructing a Mist System

Demonstrate your ability to construct a mist system for the propagating bench in the greenhouse according to instructions and procedures. Using 1/2 inch galvanized pipe which is the length of the propagation bench, install mist nozzles, equip with electronic water valve and a timing mechanism.

I. Tools Needed:

A. Pipe cutter

B. Pipe Reamer

C. Pipe Threader

D. Pipe Wrench

E. Drill and bit

II. Materials Needed:

A. 1/2 inch galvanized pipe (The length of the propagation bench)

B. 1/2 inch pipe cap

C. One solenoid controlled water valve.

D. One 24-hour timer

E. One 6-minute timer

F. Figure number of mist nozzles needed

G. Pipe conduit (Long enough to reach from timing box to solenoid)

H. Wire cable 12-2 with ground (Long enough to reach from timing box to solenoid.)

I. Brackets (for supporting mist system)

III. Procedures:

A. Thread both ends of the pipe

B. Drill a series of holes in the pipe, two inches apart, starting one foot from end.

(NOTE: Holes must be in a straight line on the pipe.)

C. Tap threads in the holes.

(NOTE: Drill bit and tap size will depend on the kind of size of the mist nozzles selected.)

D. Using a water hose, flush the debris from the pipe.

E. Place the pipe cap on one end of the pipe.

F. Install the mist nozzles in the pipe.

JOB SHEET #6: Constructing a Mist System

G. Install the 24-hour timer to the wall or a board on the end of the bench.

H. Connect the six minute timer to the 24 hour timer. (So six minute timer operates only while the 24 hour timer is operating.)

I. Connect the solenoid controlled water valve to the six minute timer.

J. Connect a water supply to the water valve.

(NOTE: A water hose will serve as a temporary water supply until a permanent one can be installed.)

K. Activate the timers so that the misting system is functioning.

L. Adjust the height of the misting pipe so that the entire propagating bench is receiving an equal amount of water.

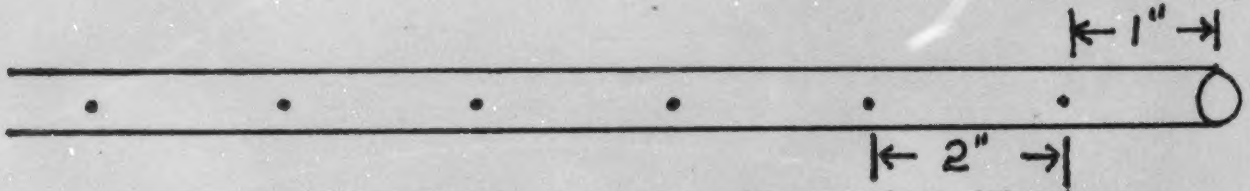
M. Affix the pipe mounting brackets to permanently support the misting pipe.

N. Construct a permanent water supply.

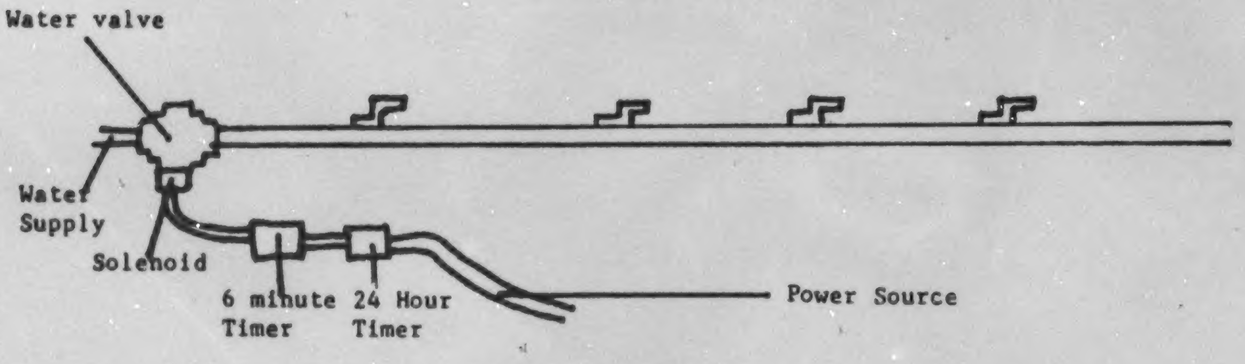
O. Adjust the timers so that they deliver the desired amount of water daily.

(NOTE: Timers should be placed in a dry location to prevent electrical accidents.)

IV. Diagram of Procedure:



A. Mist pipe with holes for mist nozzles properly positioned.



B. Example of propagation bench with mist system.

HORTICULTURE MECHANICS
UNIT 1
TEST

1. Define the following terms:

   a. Trap
   b. House drain
   c. Plumbing
   d. Soil pipes
   e. Fittings

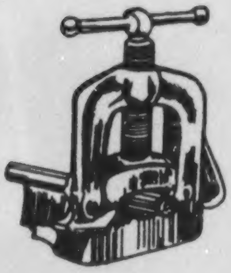
2. Name five kinds of pipe and give one use of each.

3. Name two reasons for using threading compounds.

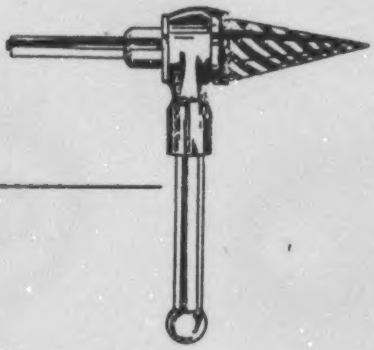
4. Name four reasons for using cutting oil when threading pipe.

TEST

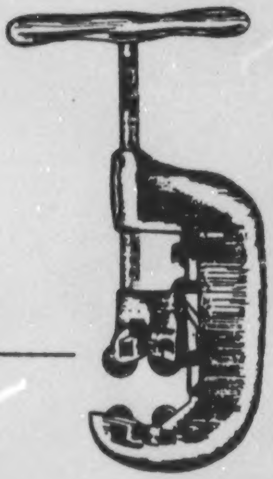
5. Identify the following tools.



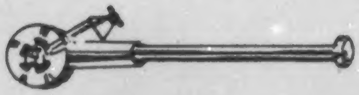
a.________________



b.________________

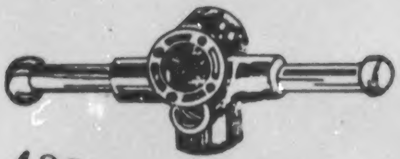


c.________________



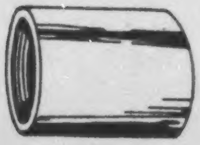
d.________________

e.________________

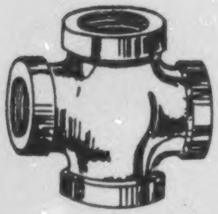


TEST

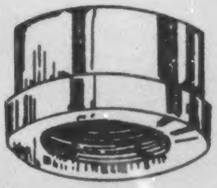
6. Identify the following pipe fittings.



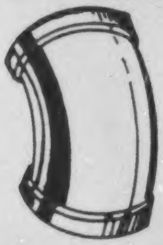
a. ______________



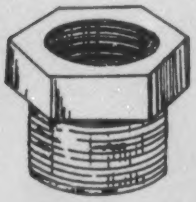
b. ______________



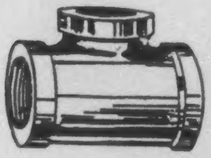
c. ______________



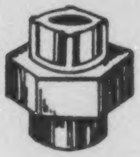
d. ______________



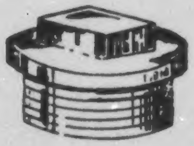
e. ______________



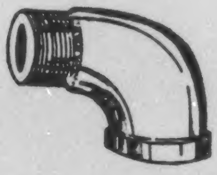
f. ______________



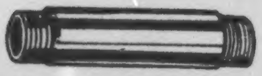
g. ______________



h. ______________



i. ______________



j. ______________

TEST

7. What are five common sizes of pipe used in plumbing?

8. How can you distinguish between bolt and pipe threads?

9. a. How is bolt size measured?

   b. How is pipe size measured?

10. List the five classes of plastic pipe.

11. Performance tests will be conducted for the following:
    a. Cutting pipe
    b. Reaming pipe
    c. Threading pipe
    d. Soldering pipe (copper)
    e. Connecting PVC pipe
    f. Constructing a Mist System

HORTICULTURE MECHANICS

UNIT 2

RAFTER FRAMING

TERMINAL OBJECTIVE

Upon completion of this unit, students will be able to identify the parts of a steel framing square and be able to interpret the various tables found on the square. Using this information the student will be able to lay out common rafters. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, students will be able to:

1. Define terms associated with rafter cutting.
2. Identify the parts of a framing square.
3. Identify the various tables found on the framing square and name one use of each.
4. Identify five types of roof from an illustration.
5. Identify four kinds of rafters when given a drawing illustrating the various kinds.
6. Name the three methods of determining the length of common raters.
7. Demonstrate the ability to lay out and cut common rafters.

HORTICULTURE MECHANICS

UNIT 2

INFORMATION SHEET

I. Terms and Definitions

A. Span - The distance over the plates.

B. Run - The shortest horizontal distance measured from a plumb line through the center of the ridge to the outer edge of the plate.

C. Rise - The vertical distance from the top of the ridge to the level of the birds mouth, rise = pitch times 2 times the run.

D. Pitch - The slope or slant of a roof expressed as rise in inches per foot of run.

E. Plate - The roof member to which rafters are framed at the lower end.

F. Ridge board - A horizontal roof member used for connecting the upper ends of the rafters.

G. Rafter - A supporting roof member.

H. Common rafter - The rafter extending at right angles from the plate to the ridge.

I. Hip rafter - A rafter extending diagonally from the corner of the plate to the ridge.

J. Valley rafter - A rafter extending diagonally from plate to ridge at the point of intersection of two roof surfaces.

K. Jack rafter - A rafter that does not extend from plate to ridge

L. Hip jack - The rafters which extend from the ridge to the hip rafters.

M. Valley jack - The rafters which extend from the ridge to the valley rafters.

N. Ridge cut - The cut end which rests against the plate.

O. Seat cut - The cut end which rests against the plate.

P. Side cuts - The fittings for other roof members.

(Example: Hip, valley, and jack rafters have side cuts where they fit against other roof members.)

Q. Measuring line - A line on which the rafter length is measured.

R. Tail - The position of a rafter extending beyond the plate.

S. Foot line - The horizontal plane level with the top of the plate.

T. Cripple jack - The rafters which extend from a hip rafter to a valley rafter.

U. Birds mouth - Notch cut in rafter to fit plate.

V. Tail cut - The cut at the end of the tail.

INFORMATION SHEET

II. Steel Framing Square (TM2)
  A. Made in form of right angle
  B. Has two arms
    1. Body - 24 inches long, 2 inches wide
    2. Tongue - 16 inches long, 1 1/2 inches wide.
  C. Heel - Where the tongue and body meet.
  D. Face - The visible side when body is held in left hand and the tongue in right hand, with heel up.
  E. Back - Opposite side of face.

III. Tables Found on Framing Square (TM 3)
  A. Essex
    1. Located on back of the body
    2. Used in figuring board feet
  B. Octagon
    1. Located on face of tongue
    2. Used to lay off an eight-sided figure from a four-sided figure
  C. Brace
    1. Located on back of tongue
    2. Used in figuring the length of common braces
  D. Rafter
    1. Located on face of body
    2. Used in determining length and cuts of all rafters.

IV. Types of Roofs (TM 4).
  A. Lean-to
  B. Gable
  C. Hip
  D. Gable and valley
  E. Hip and valley
  F. Flat
  G. Quonset
  H. Deck

V. Kinds of Rafters (TM 5).
  A. Common

4

INFORMATION SHEET

B. Jack

C. Valley

D. Hip

VI. Finding Lengths of Common Rafters (TM 6).

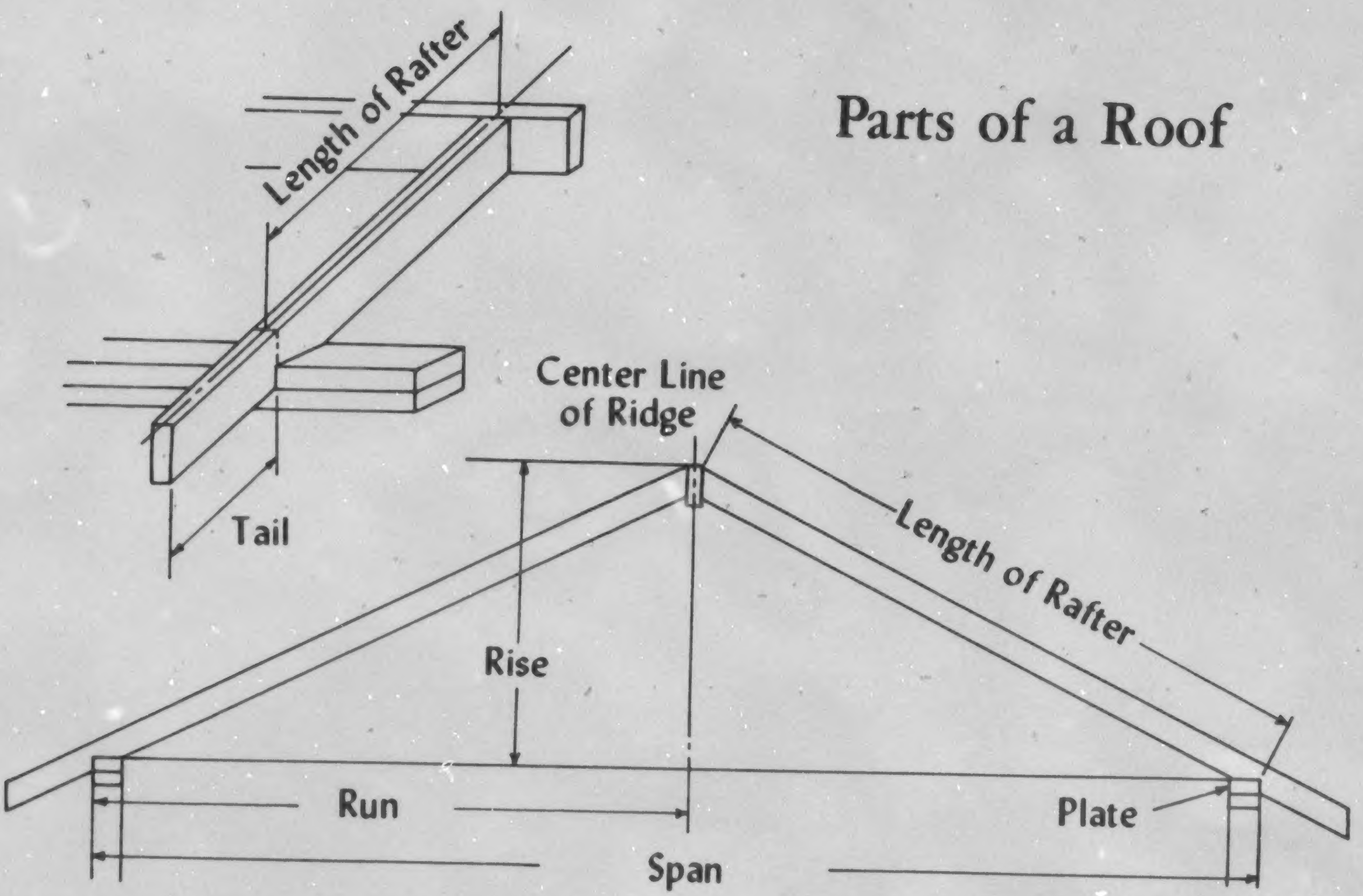
A. Mathematical method

B. Scaling method

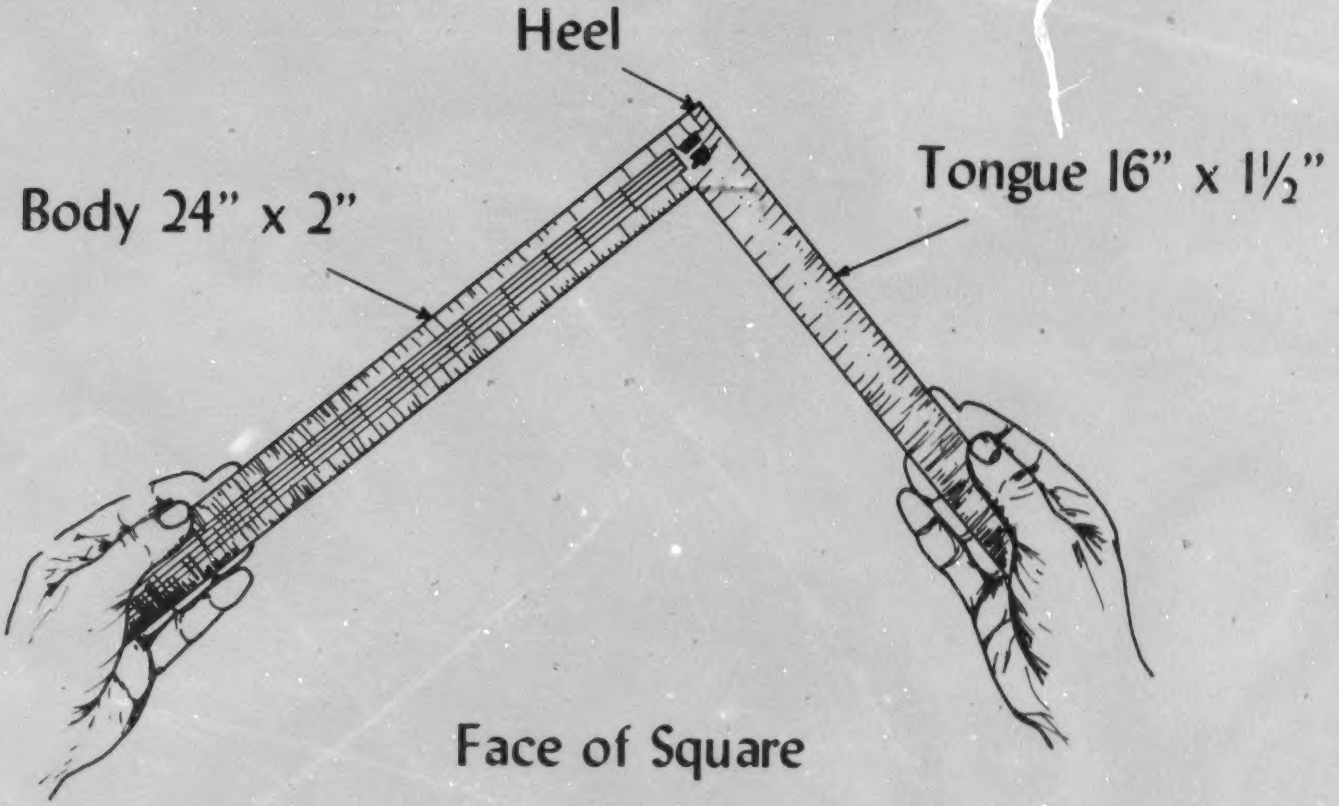
C. Stepping method

D. Rafter table method

Parts of a Roof

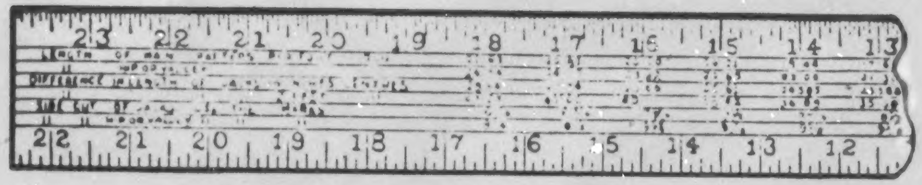

Length of Rafter
Tail
Center Line of Ridge
Length of Rafter
Rise
Run
Plate
Span

Parts of Steel Framing Square


Heel
Body 24" x 2"
Tongue 16" x 1½"

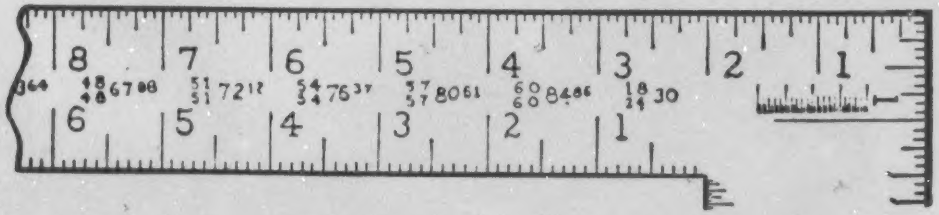
Face of Square

Framing Square Tables



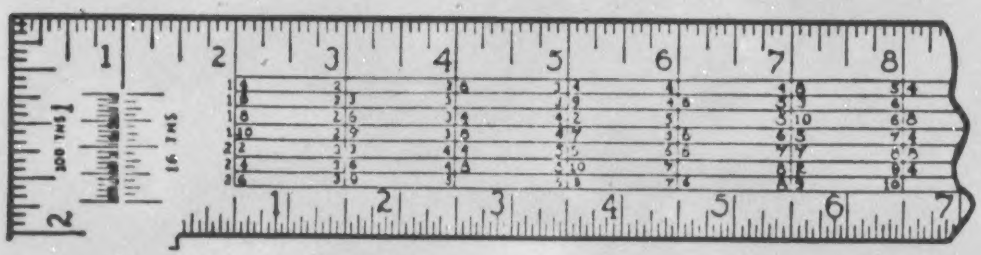
23 22 21 20 19 18 17 16 15 14 13
LENGTH OF MAIN RAFTERS PER FOOT RUN
DIFFERENCE IN LENGTH OF JACKS 16 INCHES CENTERS
SIDE CUT OF JACKS
22 21 20 19 18 17 16 15 14 13 12

Rafter or Framing Table



8 7 6 5 4 3 2 1
6 5 4 3 2 1

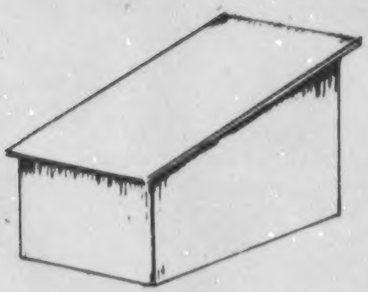
Essex Table

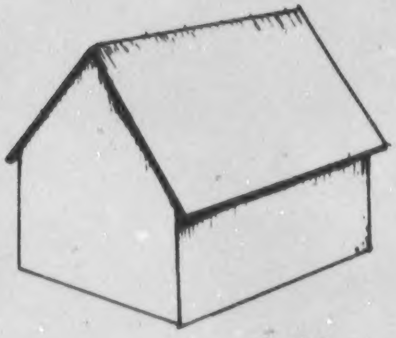


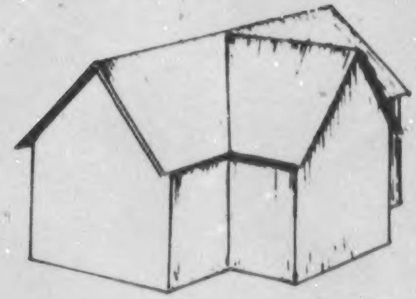
1 2 3 4 5 6 7 8
100 THS
16 THS
1 2 3 4 5 6 7

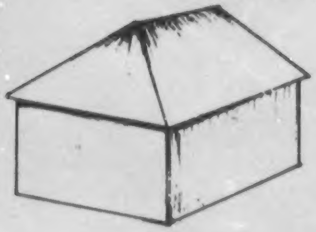
Brace Table

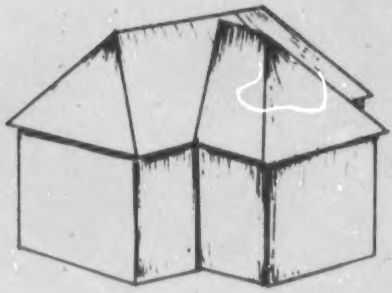
Types of Roofs


Lean-To

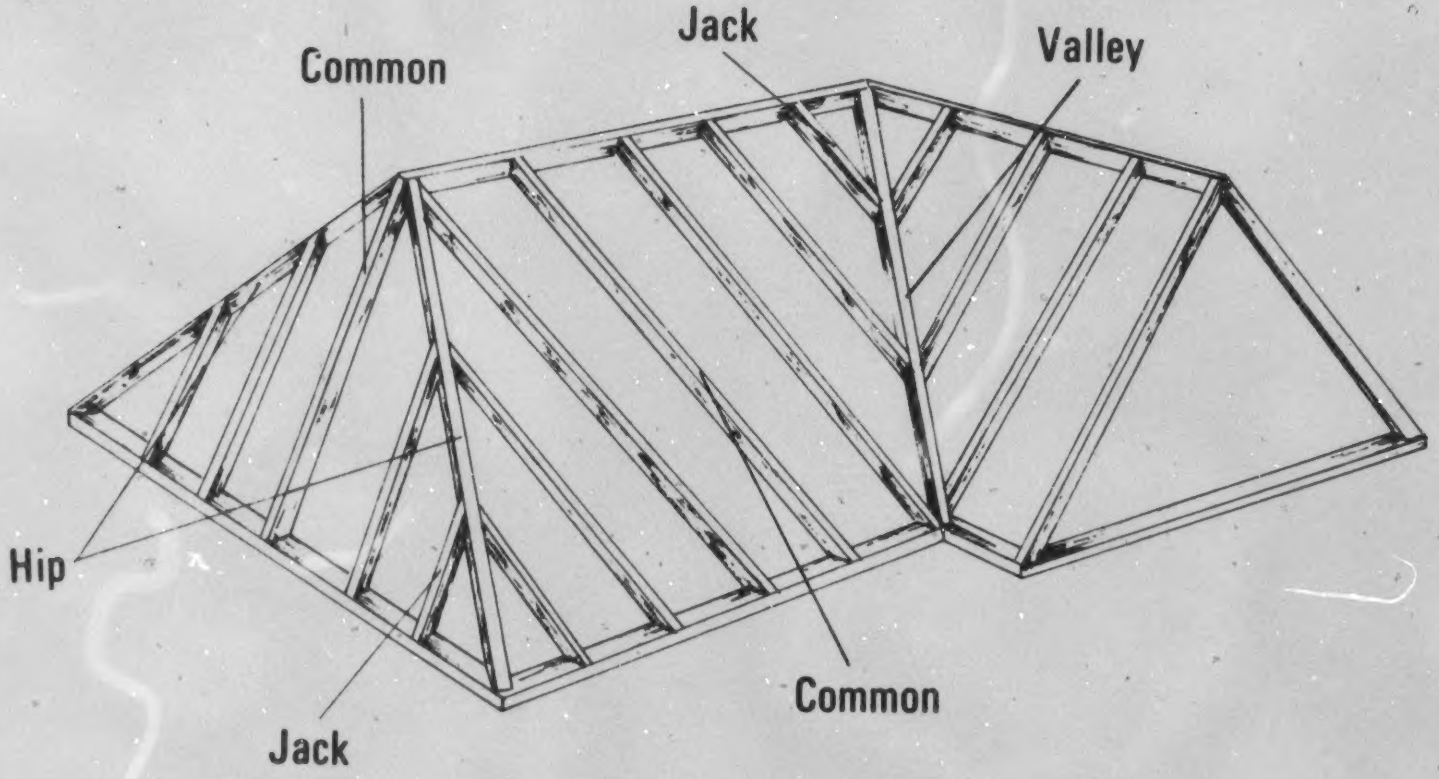

Gable


Gable and Valley

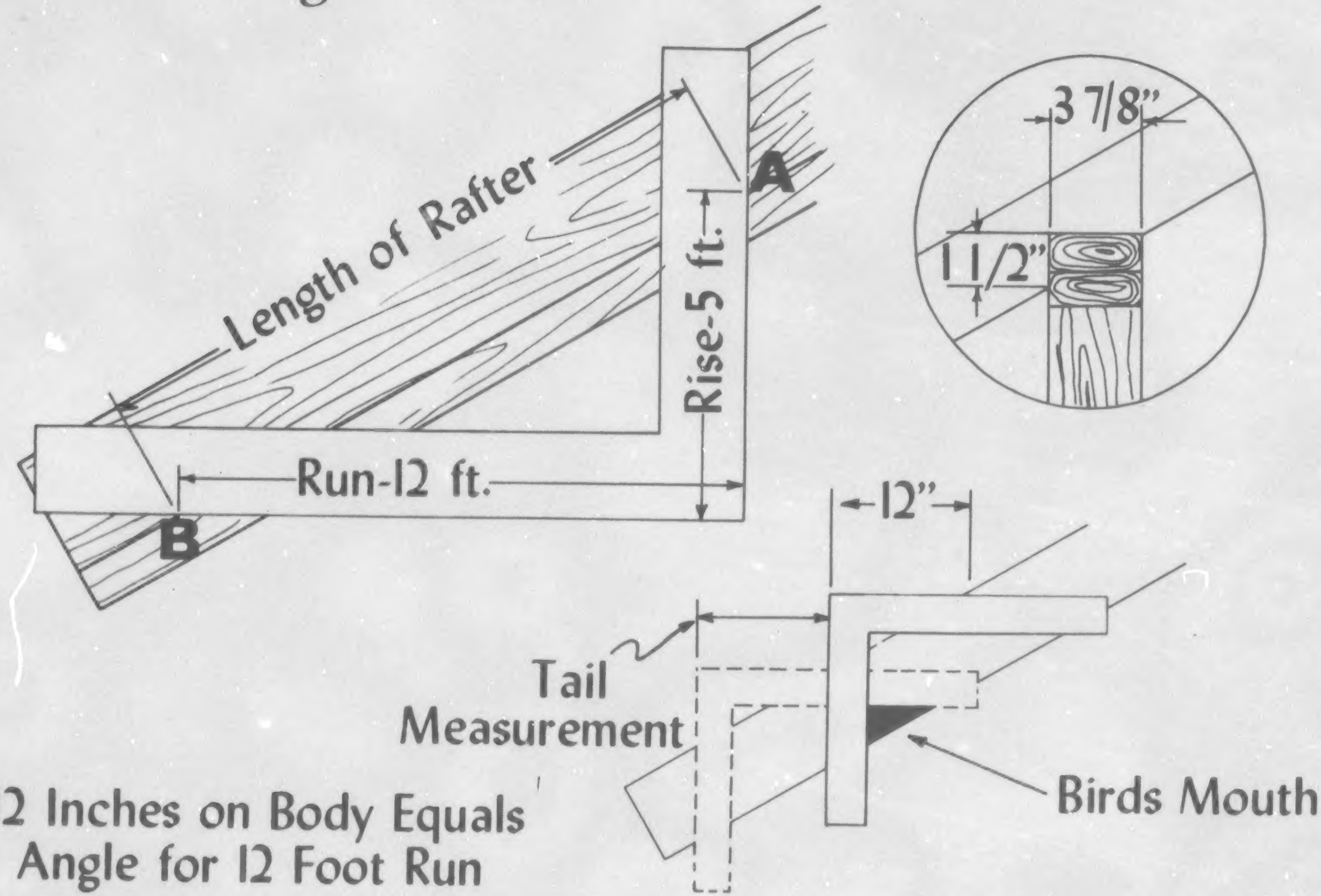

Hip


Hip and Valley

Kinds of Rafters


Jack
Valley
Common
Hip
Jack
Common

Cutting a Rafter


Length of Rafter
A
Rise-5 ft.
Run-12 ft.
B
3 7/8"
1 1/2"
12"
Tail Measurement
Birds Mouth

12 Inches on Body Equals Angle for 12 Foot Run

RAFTER FRAMING

UNIT 2

JOBSHEET #1: Lay Out a Common Rafter by Stepping Method

I. Tools and Materials Needed:

A. Square with a rafter table

B. Pencil

C. 2 x 4 or 1 x 4 stock of wood or cardboard.

II. Procedures:

A. Figure the span - width of building, outside of plate to outside of plate. Example 12' wide.

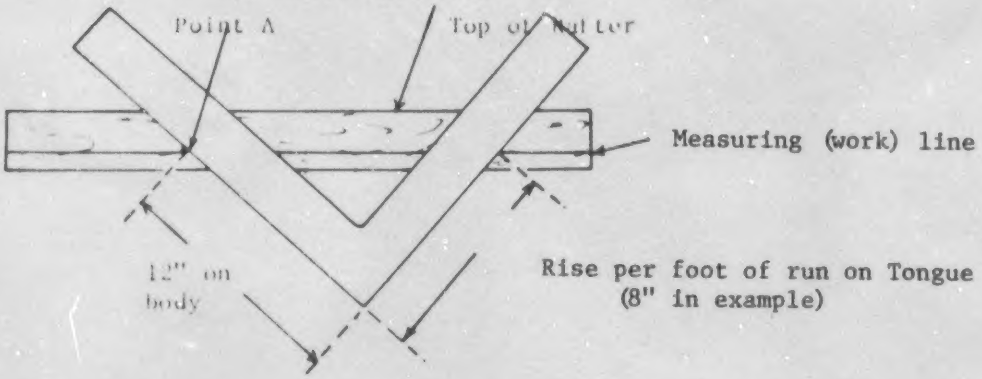
B. Figure run - run is usually 1/2 of the span or the horizontal distance covered by one rafter. Example 1/2 X 12 = 6'.

C. Figure rise - the vertical distance from top of the ridge to the level of the foot. Example rise 4'

D. Figure pitch of roof - pitch equals rise divided by span. Example P = R/S = 4/12 = 1/3 pitch.

E. Figure rise per foot of run - rise per foot of run is equal to pitch times 24 on rise X 12 divided by length of run. Example 1/3 X 24 = 8" or 4 X 12/6 = 8"

F. Draw measuring line on rafter - lay tongue of square on bottom of rafter and draw line along top of tongue. (NOTE: If rafter has a bow, the bow always is placed up.)



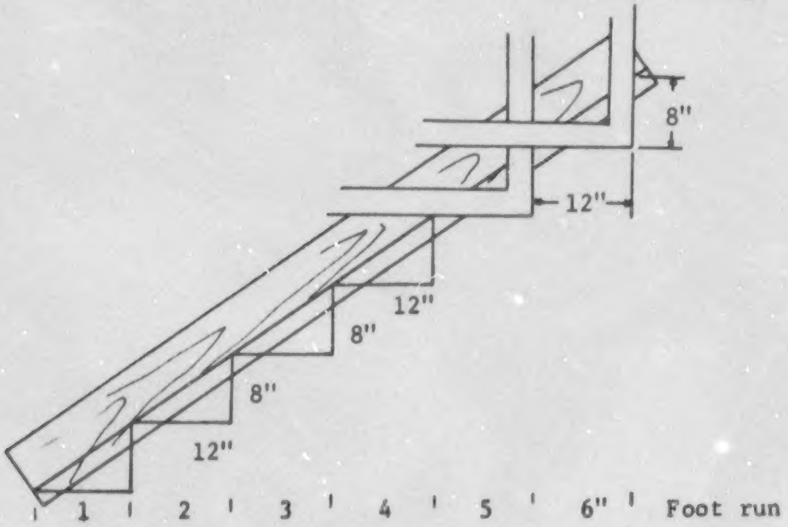
G. Determine rafter figures to use - on a common rafter, use 12 on the outside of body and rise per foot of run (8" in example) on outside of tongue.

H. Lay square on upper end of rafter as shown in Figure 1.

I. Draw the ridge cut along tongue of square and make a mark on the measuring line by body. (Point A, Figure 1.)

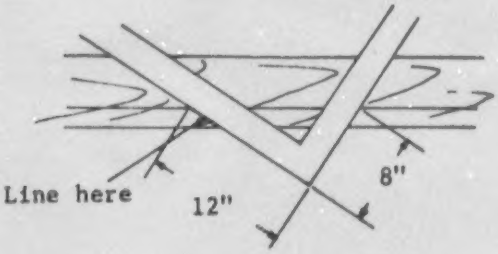
JOB SHEET #1: Lay Out a Common Rafter by Stepping Method

J. Step down work line maintaining 12" rise per foot of run (8") on square, as shown in Figure 2. Since each step of square measures one foot of run, you must make the same number of steps with the square as there are feet of run of the building.


8"
12"
12"
8"
8"
12"
1
2
3
4
5
6"
Foot run

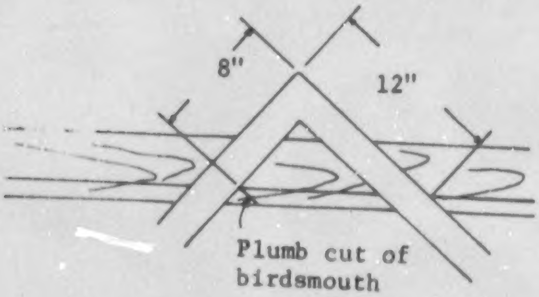
K. The last mark indicates the rafter length and the location of the birdsmouth.

L. Draw a line through mark to bottom of the rafter on the body.


Line here
12"
8"

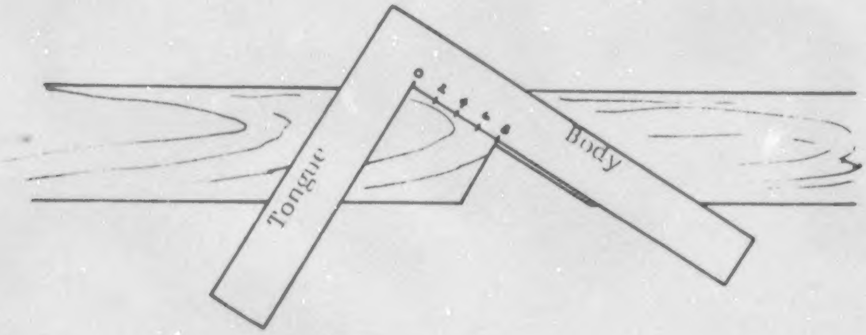
M. Turn square over (heel up maintaining numbers 12 & 8).

N. Place square over point to make a line perpendicular to seat cut. (Completes birdsmouth)


8"
12"
Plumb cut of
birdsmouth

JOB SHEET #1: Lay Out a Common Rafter by Stepping Method

O. Determine tail projection - place body of square in line with the seat cut as shown in figure.



P. Measure horizontal tail projection in inches on body (if 8" projection place 8 on birdsmouth point).

Q. Draw a tail cut using tongue and turn in to instructor.

RAFTER FRAMING

UNIT 2

JOBSHEET #2: Lay Out and Cut a Common Rafter by the Rafter Table Method

I. Tools and Materials:

- A. Square with a rafter table
- B. Pencil
- C. 2 x 4 or 1 x 4 stock of wood or cardboard

II. Procedures:

- A. Figure span - width of building, outside of plate to outside of plate. Example 12' wide.
- B. Figure run - run is usually 1/2 of span or the horizontal distance covered by one rafter. Example 1/2 of 12 = 6'.
- C. Figure rise - vertical distance from top of ridge to level of foot. Example rises 4'
- D. Figure pitch of roof - pitch equals rise divided by span. Example pitch = 4/12 = 1/3.
- E. Figure rise per foot of line - rise per foot of run is equal to ptich times 24 or rise times 12 divided by length of run. Example 1/3 x 24 = 8" or 4 x 12/6 = 8".
- F. Place measuring line on rafter - lay tongue of square on bottom of rafter and draw line. (NOTE: If rafter has a bow, the bow is always placed up.)
- G. Locate rafter length per foot of run on rafter table for common rafters - First find on the "inch line" on the top edge of the body the figure that is equal to rise per foot of run. - Read first line under figure. (Need drawing similar to Figure 22 and Figure 23 on page 17 & 18 of Stanley Steel Square Booklet.) Example under 8", first line, find 14.42"
- H. Determine rafter length - rule: Multiply the "Length given in table" by the number of feet run. Example 14.42 x 6 = 86.52".
- I. Determine rafter figures to use - use 12 on outside of body and rise per foot of run on tongue - (12 & 8). All cuts are made with these two figures.
- J. Place ridge cut on upper end of rafter. (Drawing Figure 1 of Worksheet 1).
- K. Mark rafter length on work line.
- L. Mark seat cut - using 12 on body and rise per foot of run on tongue. (NOTE: Seat cut is always perpendicular to ridge cut).

JOB SHEET #2: Lay Out and Cut a Common Rafter by the Rafter Table Method

M. Place plumb cut of birdsmouth on rafter: (NOTE: Must be parallel to ridge cut.)

N. Determine tail projection - place body of square in line with the seat cut. Example 5" horizontal overhang.

O. Measure horizontal rafter projection in inches on the body.

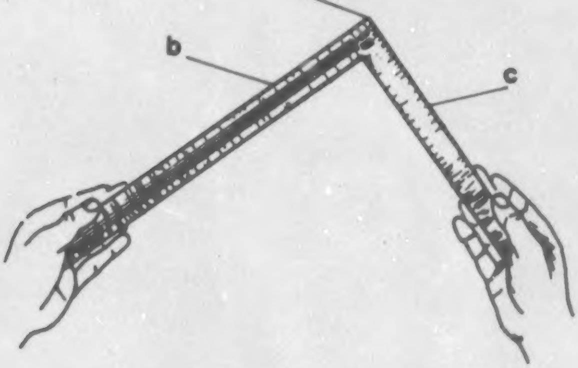
RAFTER FRAMING

UNIT 2

TEST

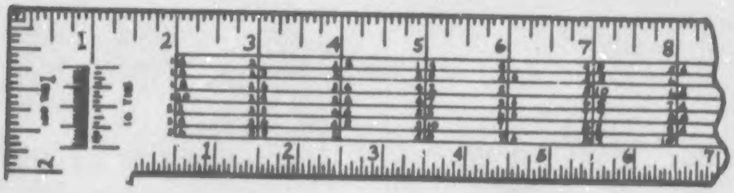
1. Define the following terms.
   a. Pitch
   b. Run
   c. Rafter
   d. Common rafter
   e. Seat cut

2. Identify the parts of the steel framing square.



a.________________ b.________________ c.________________

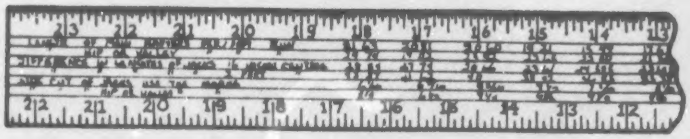
3. Identify the following tables found on the steel framing square and name one use of each.



a.________________________

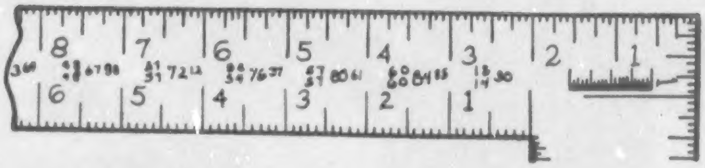
Use________________________

TEST


23
22
21
20
19
18
17
16
15
14
22
21
20
19
18
17
16
15
14
13
12

b. ______________________________

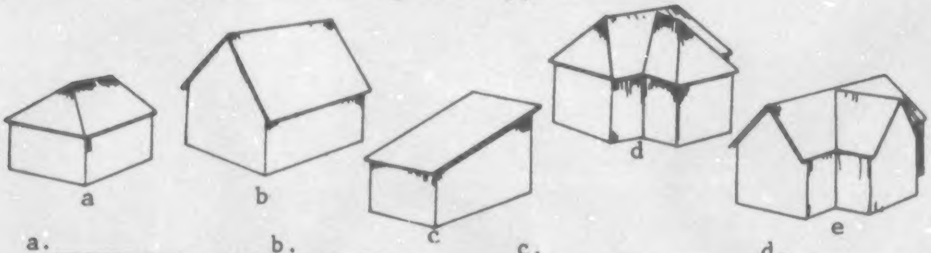
Use ______________________________


8
7
6
5
4
3
2
1
6
5
4
3
2
1

c. ______________________________

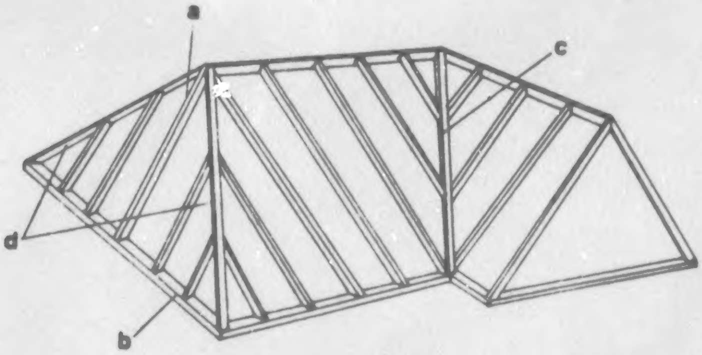
Use ______________________________

4. Identify the following roof types.



a.________________ b.________________ c.________________ d.________________
e.________________

5. From the drawing below label the various kinds of rafters.



a. ______ c. ______
b. ______ d. ______

TEST

6. Name three methods of determining the length of common rafters.

7. Demonstrate the procedures for laying out and cutting common rafters.
   (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity is to be completed.)

HORTICULTURE MECHANICS

UNIT 3

UTILITY BUILDINGS

TERMINAL OBJECTIVE

Upon completion of this unit, the student will be able to match terms associated with farm buildings, list the common types of foundations, and identify types of roof framing. Using this information the student will be able to identify the kinds of roofing materials and the methods of attaching siding. This objective will be considered achieved by scoring at least eighty-five percent on the test.

SPECIFIC OBJECTIVES

After completion of this unit, the student will be able to:

1. Match terms associated with utility building with the proper definition.
2. List factors to consider when planning a utility building.
3. Name building materials often used in utility buildings.
4. Identify the types of utility buildings.
5. Select from a list the causes of building failures.
6. List some common types of foundations and wall supports.
7. Identify the various types of roof framing.
8. List factors to consider when selecting roofing materials.
9. Identify the kinds of roofing materials that are commonly used on utility buildings.
10. Identify four methods of attaching siding.
11. Match the advantages and disadvantages of the various floors to the specific types of floors found in utility buildings.
12. List the characteristics to consider when selecting exterior paints.
13. Determine the cost of a utility building. (Assignment Sheet #1)

HORTICULTURE MECHANICS

UNIT 3

INFORMATION SHEET

I. Terms and Definitions

- A. Sill - Horizontal timbers which form the lowest members of a frame supporting the superstructure of a building.
- B. Stud - An upright member, usually a piece of dimension lumber, used in the framework of a wall.
- C. Plate - Term usually applied to a 2 x 4 placed on top of studs in frame walls.
- D. Purlin - A beam spanning the principle roof supports.
- E. Ridge - The highest point of a roof composed of sloping sides.
- F. Truss - A combination of members such as beams, bars, and ties usually arranged in triangular units to form a rigid framework for supporting loads over a long span.
- G. Rafters - Sloping members of a roof such as the ribs which extend from the ridge or from the hip of a roof to the eaves.
- H. Girder - A large supporting built-up horizontal member used to support walls or joints.
- I. Gussett - A brace or angle bracket used to stiffen a corner or angular piece of work.
- J. Knee brace - A framing member placed across the inside of an angle in a framework to add stiffness to the frame.

II. Factors to Consider When Planning a Utility Building

- A. Decide the size of building needed.
- B. Decide where to locate the building.
- C. Decide the type of building needed.

  (NOTE: Keep in mind the appearance of the building in relationship to other buildings at the site.)
- D. Decide the kind of materials to use.
- E. Consult persons experienced in building and in the use of utility buildings.
- F. Figure bills of materials and the total cost of the building.

  (NOTE: If hiring a contractor, bids from several contractors should be secured.)

III. Building Materials Used in Utility Buildings.

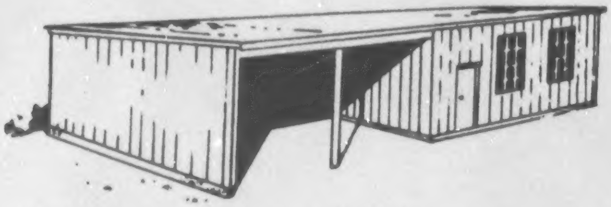
- A. Sawed lumber
- B. Logs and poles

INFORMATION SHEET

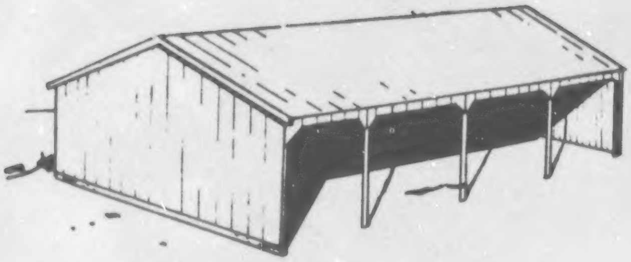
C. Concrete
D. Brick
E. Tile
F. Concrete blocks
G. Stone
H. Metal
I. Composition board and exterior plywood.

IV. Types of Utility Buildings.

A. Shed type

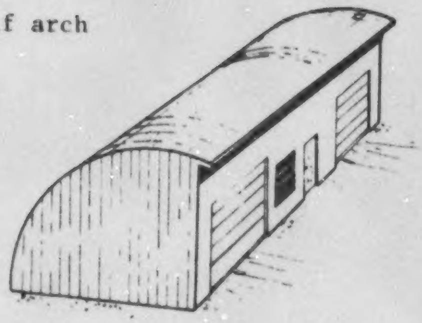


B. Gable type

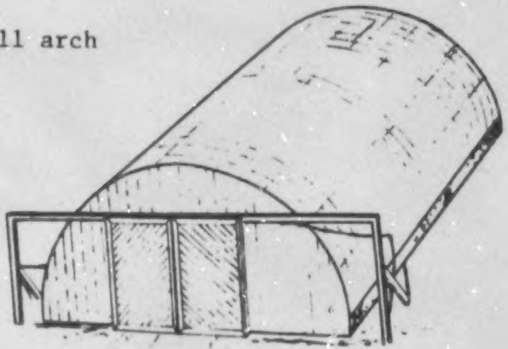


INFORMATION SHEET

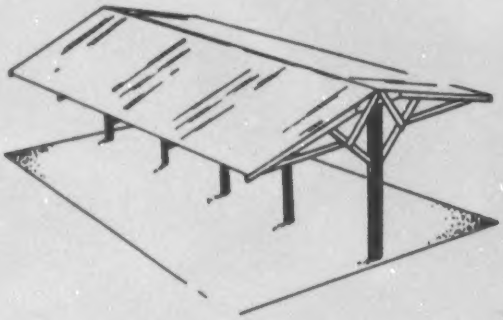
C. Half arch



D. Full arch



E. Umbrella type



V. Causes of Building Failures (TM 2)

A. Builder did not use the grade and type of material called for in the specifications.

B. Builder did not make joints as strong as the structural member.

(NOTE: The critical joints are where the sills rest on the foundation, where roof rafters or trusses rest on plates, side walls, or columns, and where the roof-ridge members are joined.)

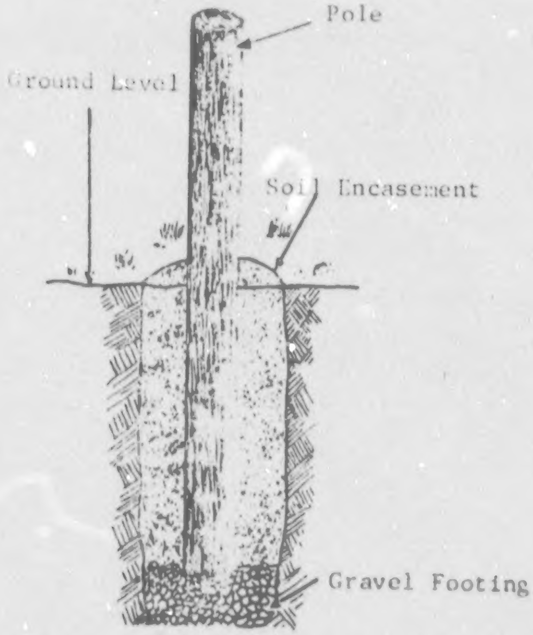
C. Inadequate foundation.

INFORMATION SHEET

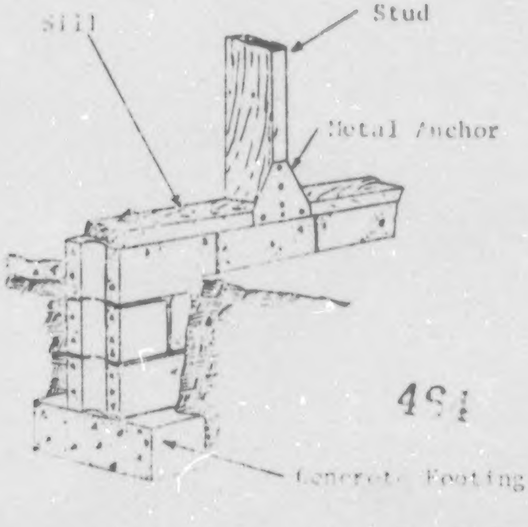
D. Poor design

VI. Common Types of Foundations and Wall Supports

A. Wood or steel poles or posts and piers.

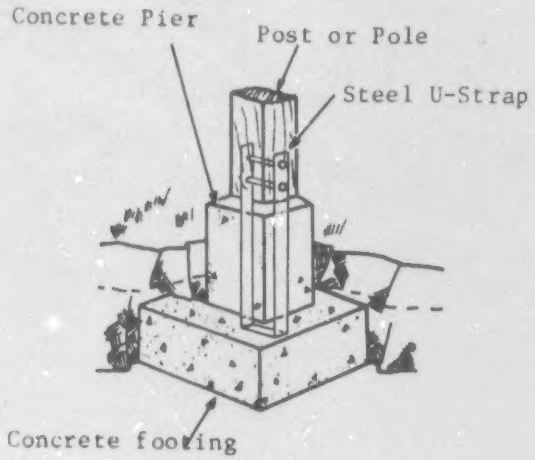

Pole
Ground Level
Soil Encasement
Gravel Footing

B. Light wood frame with masonry or concrete foundation.


Sill
Stud
Metal Anchor
Concrete Footing

INFORMATION SHEET

C. Post and girt with masonry or concrete foundation.


Concrete Pier
Post or Pole
Steel U-Strap
Concrete footing

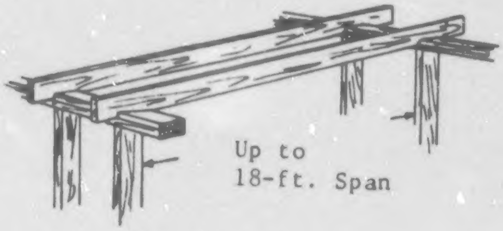
D. Masonry walls on concrete foundations.

E. Steel structures.

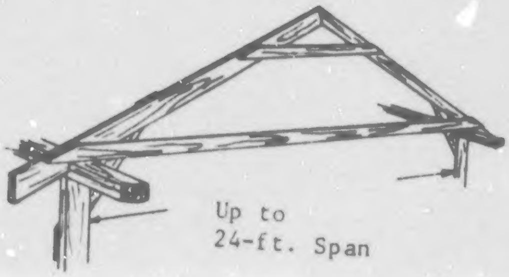
F. Combinations of above.

VII. Types of Roof Framing.

A. Common rafter

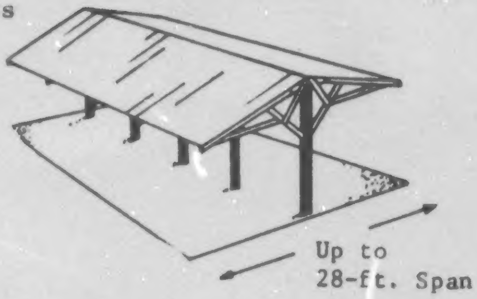

Up to
18-ft. Span

B. Truss

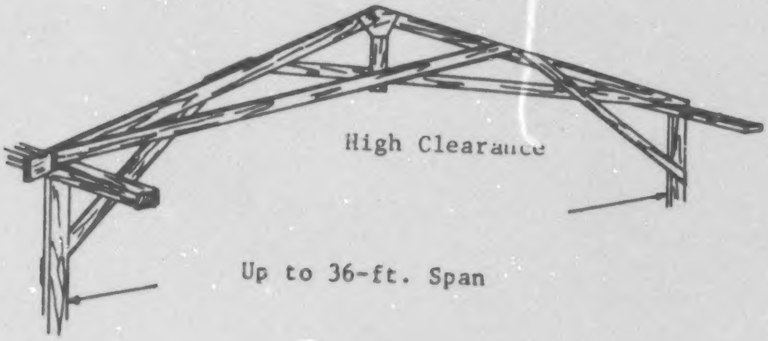

Up to
24-ft. Span

INFORMATION SHEET

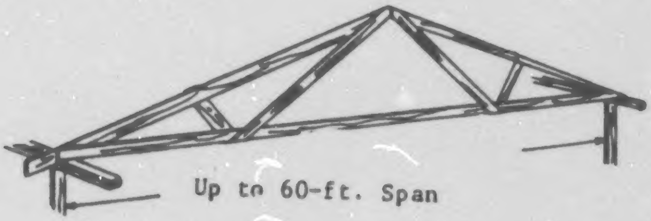
C. Umbrella truss


Up to
28-ft. Span

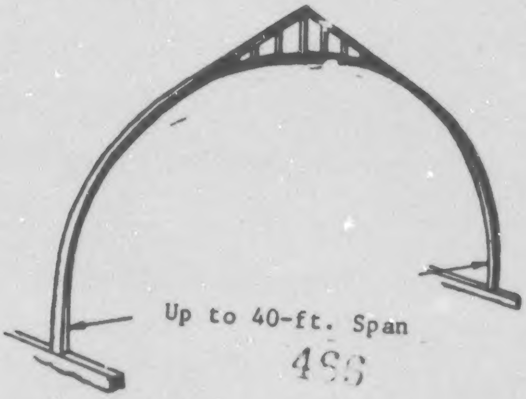
D. High clearance truss


High Clearance
Up to 36-ft. Span

E. Wide span truss

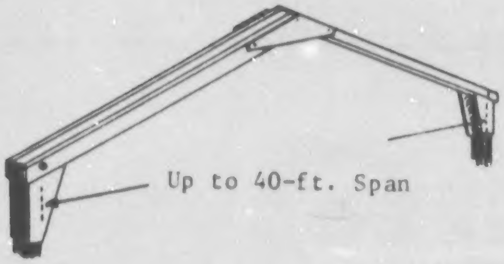

Up to 60-ft. Span

F. Curved-arch rafter

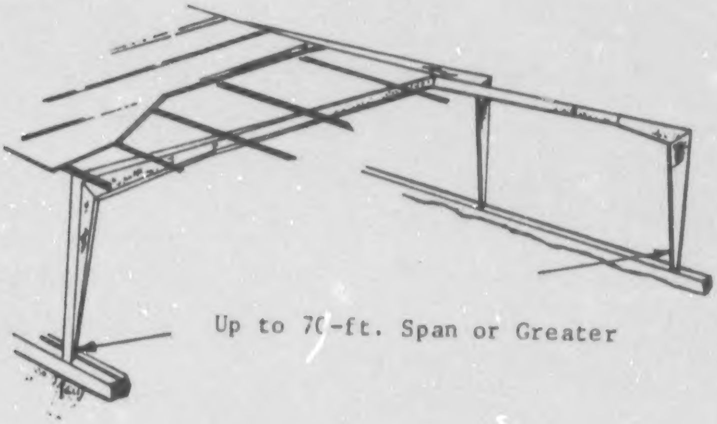

Up to 40-ft. Span

INFORMATION SHEET

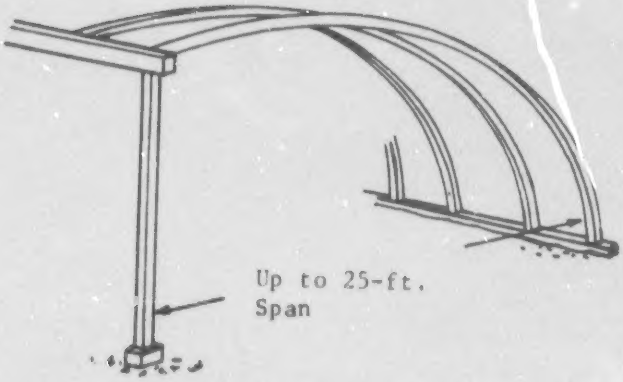
G. Rigid-wood frame


Up to 40-ft. Span

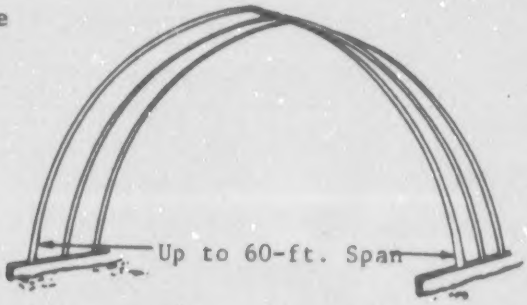
H. Rigid-steel frame


Up to 70-ft. Span or Greater

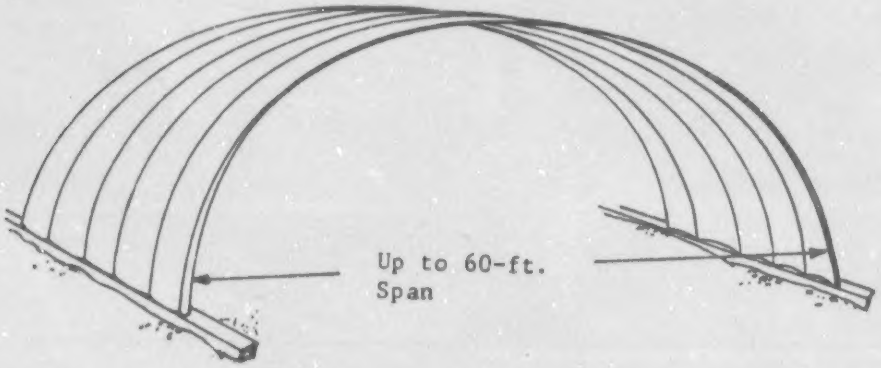
I. Steel frame


Up to 25-ft.
Span

J. Laminated rafters or steel frame

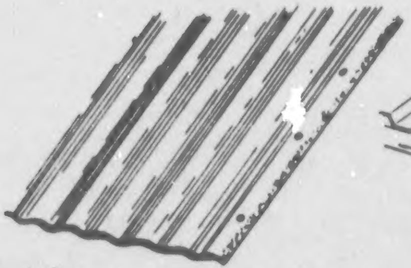

Up to 60-ft. Span

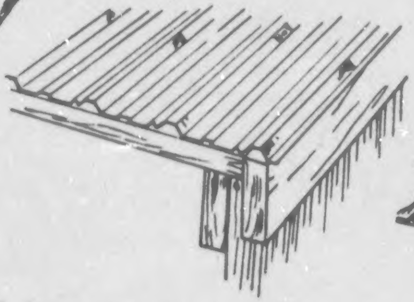
K. Frameless steel (Formed roof sheets)

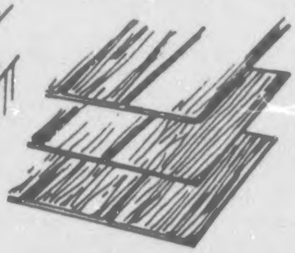


VIII. Factors to Consider When Selecting Roofing Materials

A. Probable life expectancy due to weathering.
B. Fire resistance
C. Hail resistance
D. Resistance to heat from sun
E. Resistance to strong winds
F. Maintenance
G. Kind of nailing or fastening required
H. Cost
I. Appearance
J. Ease of construction

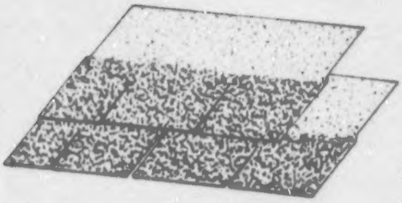

Asbestos-Cement Sheets


Galvanized Steel or Aluminum

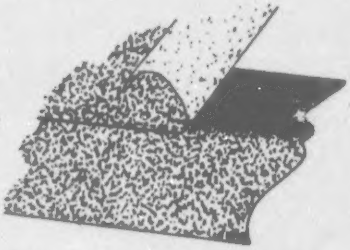

Wood Shingles

INFORMATION SHEET

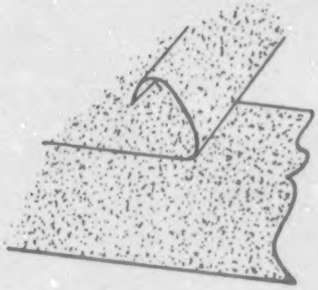
IX. Kinds of Roofing Materials



Asphalt Shingles

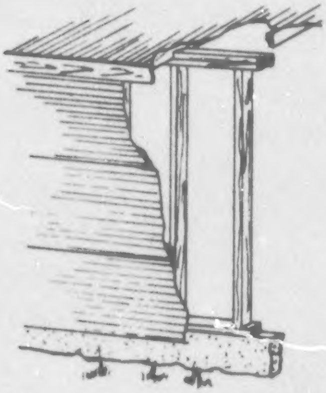


Selvage-Edge (Mineral Surface) Roll Roofing

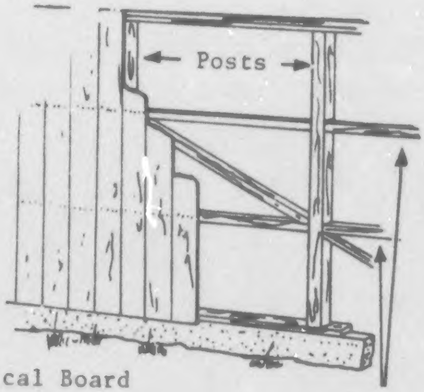


Smooth-Surfaced Roll Roofing

X. Methods of Attaching Siding.

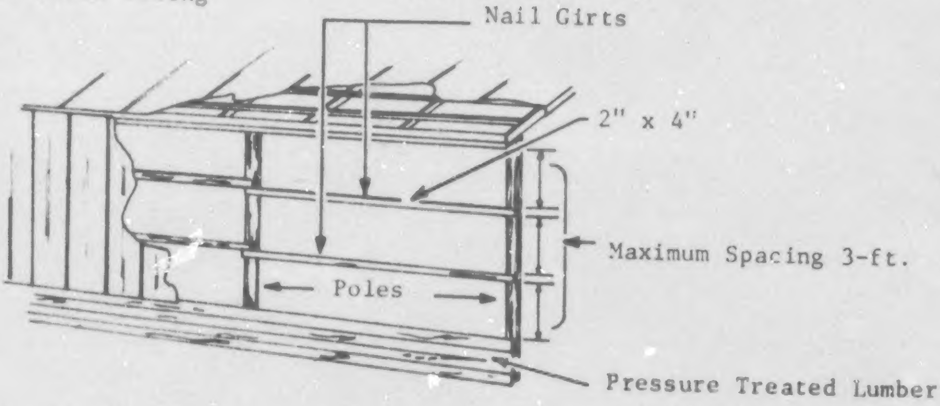


Metal Siding

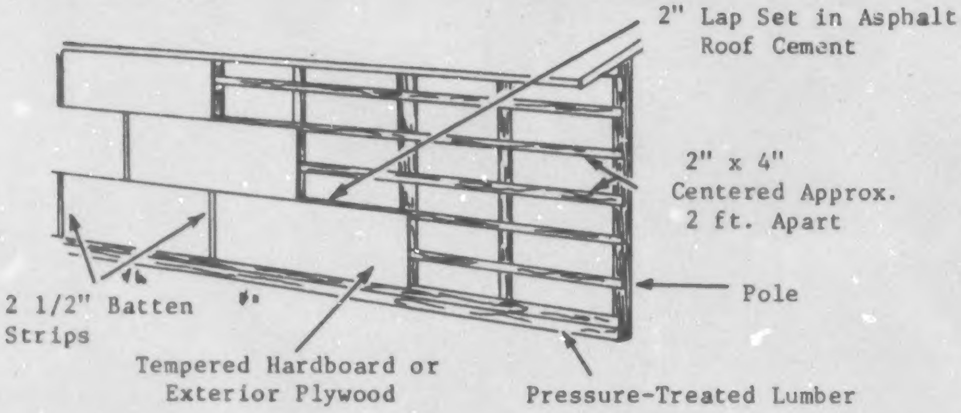

Posts
Nail Girts

Vertical Board Siding

Vertical Metal Siding


Nail Girts
2" x 4"
Maximum Spacing 3-ft.
Poles
Pressure Treated Lumber

INFORMATION SHEET


2" Lap Set in Asphalt
Roof Cement
2" x 4"
Centered Approx.
2 ft. Apart
Pole
2 1/2" Batten
Strips
Tempered Hardboard or
Exterior Plywood
Pressure-Treated Lumber

Tempered Hardboard or Exterior Plywood

XI. Advantages and Disadvantages of Various Kinds of Floors.

- A. Dirt
  - 1. Advantages
    - a. Least costly
    - b. Absorbs oil and water
  - 2. Disadvantages
    - a. Tools and equipment sink into the dirt
    - b. If floor is damp it provides enough moisture to rust tools and equipment
    - c. If the floor is dry, dust will usually be a problem with each gust of wind.
- B. Crushed rock
  - 1. Advantages
    - a. Dust is much less of a problem
    - b. Absorbs oil and water
  - 2. Disadvantages
    - a. Not satisfactory in livestock structure because of cleaning problems.
    - b. It holds dirt and grease
    - c. Tools and equipment will sink into the surface.

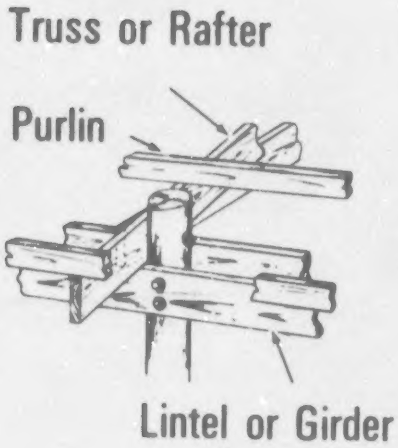
INFORMATION SHEET

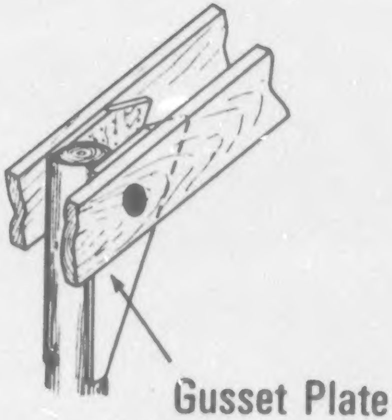
- C. Concrete
    - 1. Advantages
        - a. If properly placed, forms a hard dry surface.
        - b. Easy to keep clean.
        - c. Forms an excellent base for equipment and power tools.
        - d. Excellent for livestock structures.
        - e. It is fireproof and usually costs less than a wooden floor.
    - 2. Disadvantages
        - a. Colder than a wooden floor.
        - b. More tiring to stand on when working continuously.
        - c. More expensive than most types of floors.
- D. Wood
    - 1. Advantages
        - a. Warmer during cold weather.
        - b. Less tiring to stand on for long periods of time.
    - 2. Disadvantages
        - a. More expensive than most floors.
        - b. May not be strong enough to support heavy equipment.
        - c. Fire hazard especially in a shop.
        - d. Short life compared to concrete .

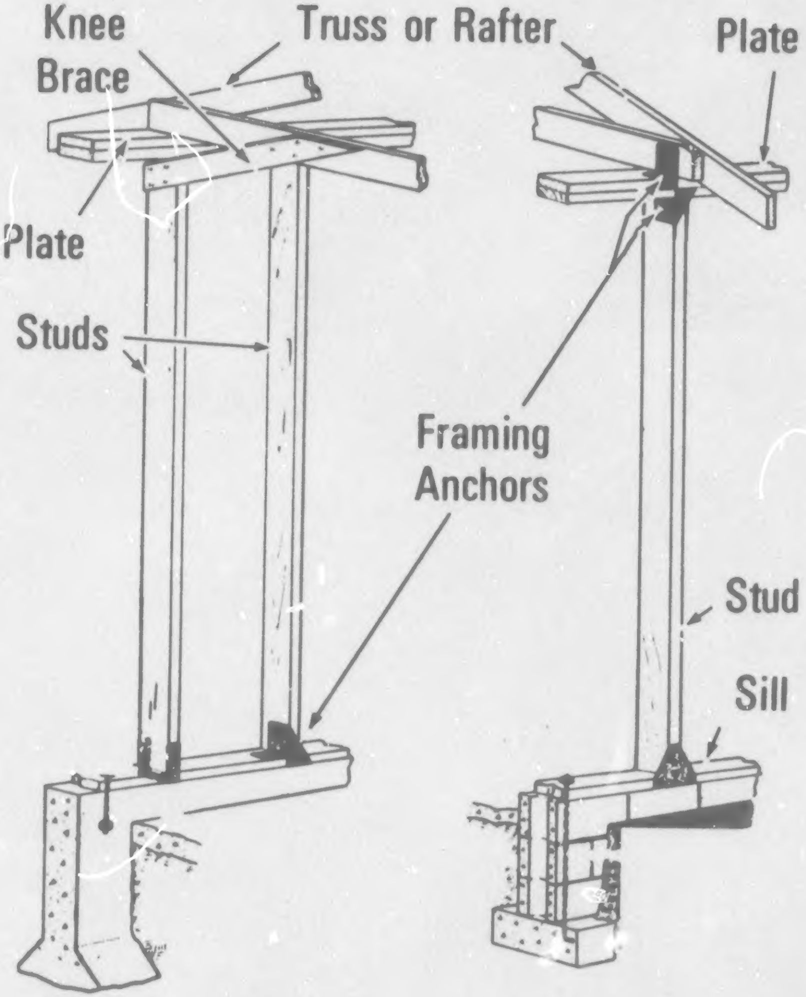
XII. Characteristics to Consider When Selecting Exterior Paints

- A. Durability
    - 1. Good white paint will give 4-5 years service.
    - 2. Good tinted paint will give 5-6 years service.
    - 3. Good dark color paint will give 6-8 years service.
- B. Self-cleaning - Wears off gradually and keeps the surface relatively clean.
- C. Highly reflective - Lighter colors will give a cooler building inside.
- D. Dirt resistant.
- E. Withstands moisture - Resistant to blistering and peeling.
- F. Resistant to stain and discoloration.
- G. Good hiding or covering qualities.

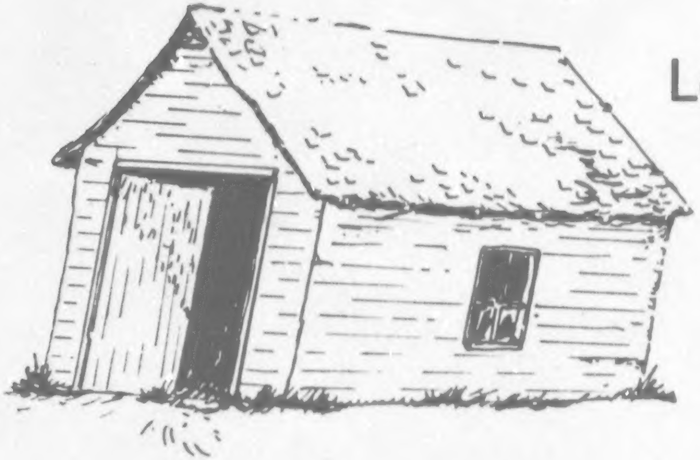
Framing Terms


Truss or Rafter
Purlin
Lintel or Girder


Gusset Plate

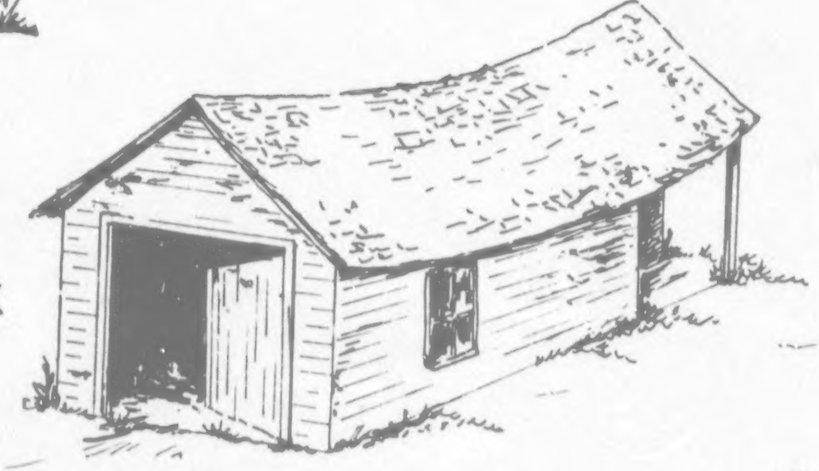

Knee Brace
Truss or Rafter
Plate
Plate
Studs
Framing Anchors
Stud
Sill

Building Failures



Leaning

Poor Bracing or Weak Joints



Sway-Back

Inadequate Roof Framing

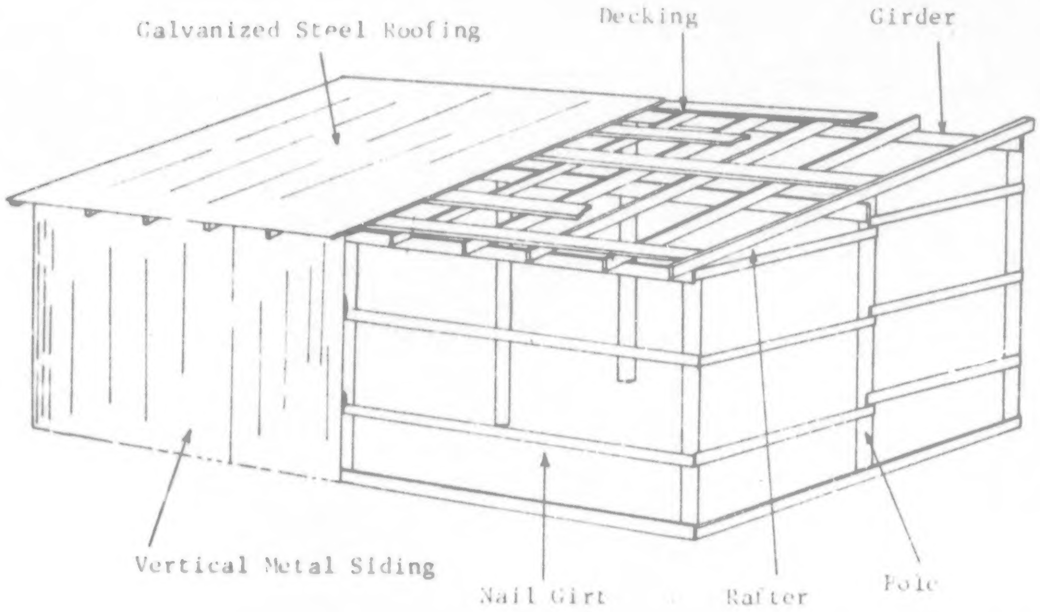
HORTICULTURE MECHANICS

UNIT 3

ASSIGNMENT SHEET #1: Determine the Cost of Utility Building

Consult your local dealer and determine the cost of constructing the following utility building:

1. Type structure - Pole type shed building.
2. Specifications
   a. 12' wide x 20' long
   b. Back and sides enclosed
   c. 8' height in front and 6' height in back
   d. Treated 6" poles - Set 4' in ground
      1. 10' spacing lengthwise
      2. 6' spacing between poles on each end and center
   e. 2" x 6" girder in front, middle, and back
   f. 24" rafter spacing - (2" x 6" lumber)
   g. 12" overhang in front and back
   h. 2" x 4" decking - (2 ft. spacing)
   i. Galvanized steel roofing - (29 gauge)
   j. Vertical metal siding - (29 gauge)
   k. 2" x 4" nail girts on back and sides - (2 foot spacing between girts)


Galvanized Steel Roofing
Decking
Girder
Vertical Metal Siding
Nail Girt
Rafter
Pole

ASSIGNMENT SHEET #1: Determine the Cost of Utility Building

3. Cost
    a. Poles - (6" diameter)
        1. Number ______ Length ______ Cost each ______
        2. ______ ______ ______
        3. ______ ______ ______
        4. Total cost of poles ____________________

        (NOTE: Poles should be four feet in ground.)
    b. Girders - (2" x 6")
        1. Number ______ Length ______ Cost/bd.ft. ______
        2. Total cost of girders ____________________
    c. Rafters - (2" x 6")
        1. Number ______ Length ______ Cost/bd.ft. ______
        2. Total cost of rafters ____________________
    d. Decking - (2" x 4")
        1. Number ______ Length ______ Cost/bd.ft. ______
        2. Total cost of decking ____________________
    e. Horizontal nail girts - (2" x 4")
        1. Back
            a. Number ______ Length ______ Cost/bd.ft. ______
            b. Cost of back girts ____________________
        2. Sides
            a. Number ______ Length ______ Cost/bd.ft. ______
            b. Cost of side girts ____________________
        3. Total cost of nail girts ____________________
    f. Metal roof - (29 gauge)
        1. Number of sheets (14') ______
        2. Cost/square ______ Cost/sheet ______
        3. Total cost of metal roof ______

ASSIGNMENT SHEET #1: Determine the Cost of Utility Building

g. Metal siding - (29 gauge)

1. Back

a. Number of sheets ______

b. Length ______

c. Cost/sheet ______

2. Sides

a. Length ______ Number of sheets ______ Cost/sheet ______
b. Length ______ Number of sheets ______ Cost/sheet ______
c. Length ______ Number of sheets ______ Cost/sheet ______

3. Total cost of metal siding ______________________________

h. Miscellaneous expense - (nails and bolts) $10.00

i. Total cost of 12' x 20' pole shed ________________________

HORTICULTURE MECHANICS

UNIT 3

TEST

1. Match the terms on the right with the proper definition.

_____a. A framing member placed across the inside of an angle in a framework to add stiffness to the frame.

_____b. Horizontal timbers which form the lowest members of a frame supporting the superstructure of a building.

_____c. A brace or angle bracket used to stiffen a corner or an angular piece of work.

_____d. An upright member, usually a piece of dimension lumber, used in the framework of a wall.

_____e. Term usually applied to a 2 x 4 placed on top of studs in frame walls.

_____f. A large supporting built-up horizontal member used to support walls or joints.

_____g. A beam spanning the principle roof supports.

_____h. The highest point of a roof composed of sloping sides.

_____i. Sloping members of a roof such as the ribs which extend from the ridge or from the hip of a roof to the eaves.

_____j. A combination of members such as beams, bars and ties, usually arranged in triangular units to form a rigid framework for supporting loads over a long span.

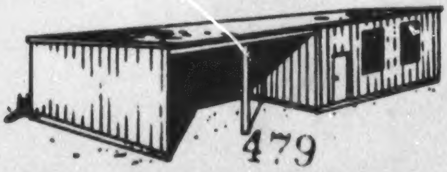
1. Sill
2. Stud
3. Plate
4. Purlin
5. Ridge
6. Truss
7. Rafters
8. Girder
9. Gusset
10. Knee brace

2. List three factors to consider when planning a building.

3. Name five building materials used in utility building.

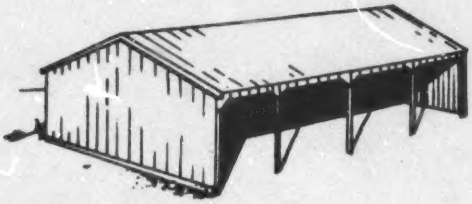
4. Identify the following types of utility buildings.

a.

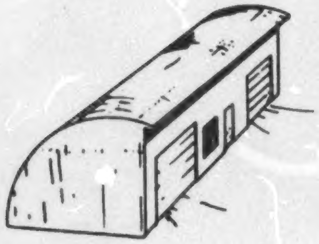


TEST

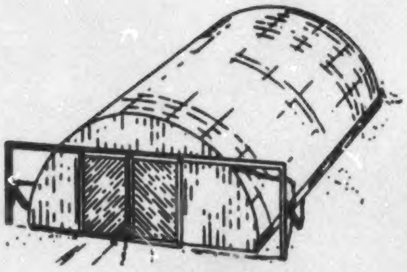
b.



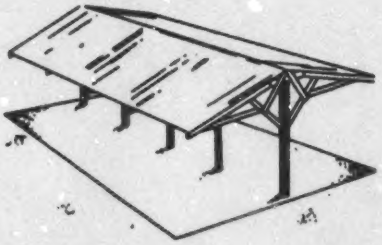
c.



d.



e.



5. Select from the list below the causes of building failures. Place an "X" by the correct statement.

_____a. Builder did not use the grade and type of material called for in the specifications.

_____b. Builder makes joints stronger than structural member.

_____c. Inadequate foundation.

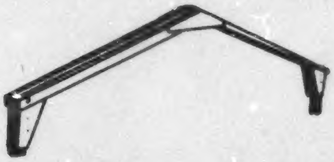
6. List three common types of foundations and wall supports.

TEST

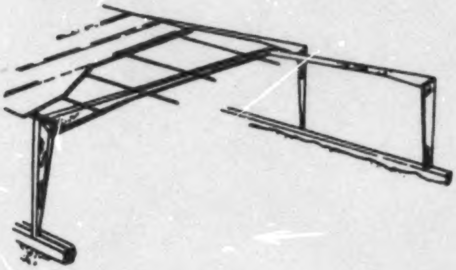
7. Identify the following types of roof framing by matching the proper titles to the illustrations.

1. Common rafter
2. Truss
3. Umbrella truss
4. High clearance truss
5. Curved-arch rafter
6. Rigid-wood frame
7. Rigid-steel frame
8. Wide span truss
9. Steel frame
10. Laminated rafters or steel frame
11. Frameless steel

______a.



______b.



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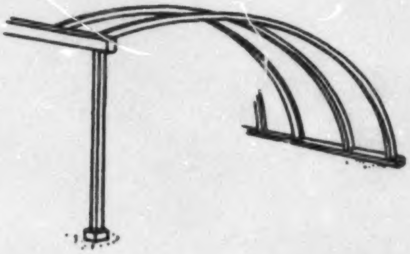

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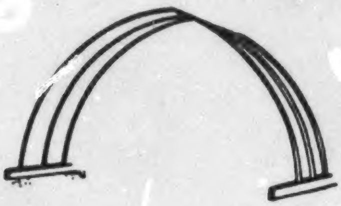

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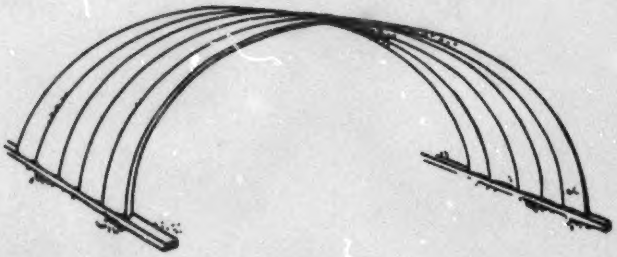

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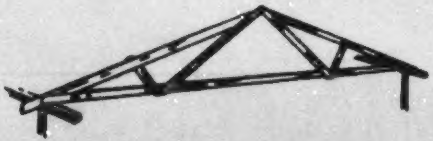

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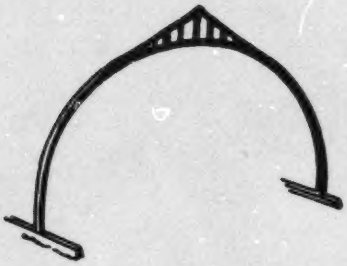
_____g.



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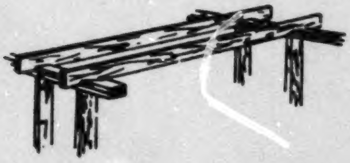
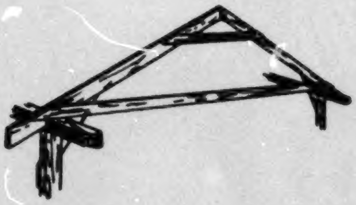
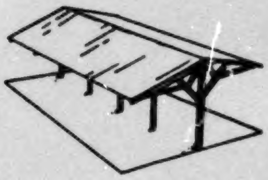


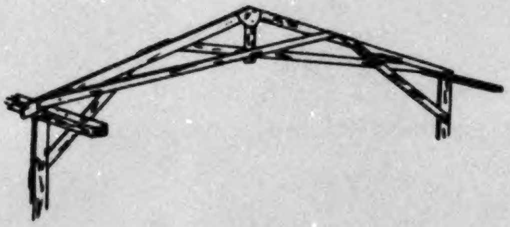
_____i.



_____j.



_____k.



TEST

8. Name five factors to consider when selecting roofing materials.

9. Identify the following roofing materials by matching the drawings to the correct materials.

_____a. Selvage-edge (mineral surface) roll roofing.

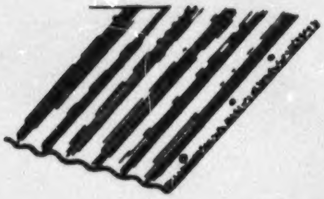
_____b. Asphalt shingles

_____c. Smooth-surfaced roll roofing.

_____d. Asbestos-cement sheets

_____e. Wood shingles

_____f. Galvanized steel or aluminum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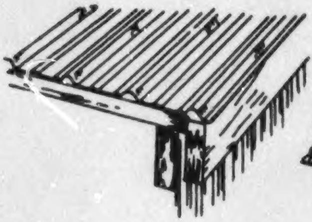
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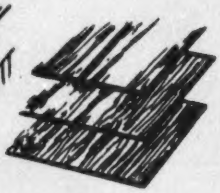
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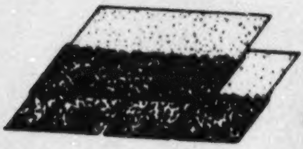
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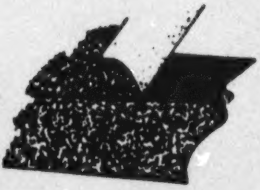
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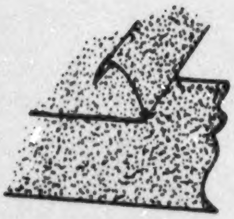

6.

TEST

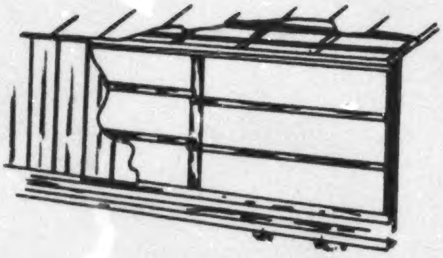
10. Identify the methods of attaching siding by matching the illustration to the proper terms.

_____a. Metal siding

_____b. Vertical metal siding

_____c. Tempered hardboard or exterior plywood

_____d. Vertical board siding



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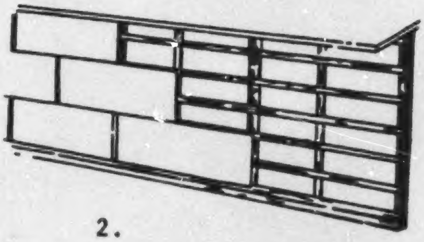

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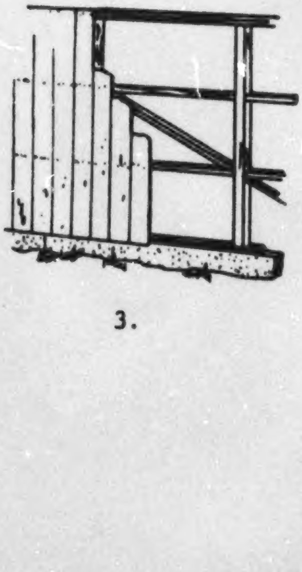

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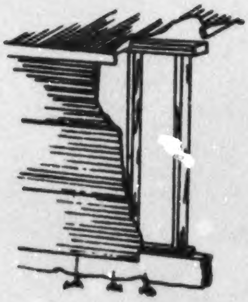

4.

TEST

11. Match the advantages and/or disadvantages of the various floors with the specific types of floors found in buildings.

    (NOTE: Advantages and disadvantages may be used on more than one type floor.)

    a. Dirt floor

    _____1)

    _____2)

    _____3)

    _____4)

    b. Crushed rock

    _____1)

    _____2)

    _____3)

    _____4)

    c. Concrete

    _____1)

    _____2)

    _____3)

    _____4)

    _____5)

    _____6)

    _____7)

    d. Wooden floor

    _____1)

    _____2)

12. List three characteristics to consider when selecting exterior paints.

13. Determine the cost of a utility building.

    (NOTE: If this has not been accomplished prior to the test, ask the instructor when the above activity should be completed.)